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Evaluation of Wetland Creation with John F. Baldwin Ship Channel Sediment

C. R. Lee, D. L. Brandon, J. W. Simmers, H. E. Tatem, and R. A. Price

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Environmental Laboratory

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Final report

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PREFACE

This report presents a wetland creation evaluation of sediment from John F. Baldwin Ship Channel performed for Messrs. Mark Dettle and Tom Kendall, project managers, U.S. Army Engineer District, San Francisco. The study was conducted by the U.S. Army Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), Vicksburg, MS, during the period July 1990 through September 1991.

Work was performed by Drs. Charles R. Lee, Soil Scientist, Henry E. Tatem, Zoologist, John W. Simmers, Research Biologist, Messrs. Richard A. Price, Research Agronomist, and Dennis L. Brandon, Statistician, Ecosystem Processes and Effects Division (EPED), ERDC.

Animal bioassessment acknowledges Mr. Lawrence Bird, Ms. Heather Holifield, and Messrs. Michael Pendarvis, and Johnny McGuffie for conducting the laboratory portion of this study. Plant bioassessment acknowledges Mses. Erica Seals and Elizabeth Tominey for laboratory analysis of sediment and plant tissue and conducting greenhouse tests. Heavy metals analyses of samples from the plant bioassay were provided by the Analytical Laboratory Group, Environmental Engineering Division, ERDC, EL. All other chemical analyses of sediment, water, and tissues were performed by Dr. Eric Crecelius, Battelle/Marine Sciences Laboratory, Sequim, WA. Sediments were collected by Dr. J. A. Word, and Messrs. J. C. Coley, and L. D. Antrim, Battelle/Marine Sciences Laboratory.

The work was conducted under the supervision of Mr. Donald L. Robey, Chief, EPED; Dr. John Keeley, Acting Director, Environmental Laboratory, and Mr. Roderick A. Chisholm II, Chief, Environmental Branch, SPN.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL James S. Weller, EN, was Commander.

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SUMMARY

Construction and improvement of the John F. Baldwin (JFB) Ship Channel were authorized by Congress in the Rivers and Harbors Act of 1965 (Public Law 89-298). The JFB Ship Channel is approximately 28 miles long, extending from the San Francisco Bar, through San Pablo Bay, into Carquinez Strait, and onto Sacramento, California. The channel will be maintained at a project depth of -45 ft relative to mean lower low water (MLLW) by dredging and removal of an estimated 800,000 cubic yards (cy) of sediment from the West Richmond reach, 7,000,000 cy from the Pinole Shoal reach and 800,000 cy from Carquinez Strait.

Traditionally, most dredged material disposal has occurred at unconfined aquatic sites within San Francisco Bay. The U. S. Army Engineer Waterways Experiment Station (WES) was asked to assist in the evaluation of other alternatives, such as upland disposal and wetland creation, for JFB sediments. Francingues et al. 1985 and Lee et al. 1991 described the Corps' Management Strategy for Disposal of Dredged Material in which a sediment is tested and evaluated for potential disposal site environments including aquatic, wetland and upland. These test protocols are used in the present evaluation to determine the potential for migration of contaminants into plants and animals under a wetland creation environment.

The objectives of this study were to address the following questions:

1. Will the sediments from West Richmond and Pinole Shoal Reaches be toxic to and/or result in the contamination of wetland plants?

2. Will the sediments from West Richmond and Pinole Shoal Reaches be toxic to and/or result in contamination of wetland animals?

3. How do test results compare to the levels of contaminants in sediments, plants and animals in existing wetlands near proposed wetland creation sites?

Laboratory tests included two plant species, *Spartina alterniflora* and *Sporobolus virginicus*, and three sediments in four replicates. Three animals, *Nassarius* (mud dogwhelks), *Nepthys* (annelids), and *Modiolus* (ribbed mussels) and three local plant species, *Spartina foliosa* and *Salicornia subterminalis* for saltmarsh mesocosms and *Scirpus olynei* and *Salicornia subterminalis* were used in the brackish wetland mesocosms with three replicates for the wetland animal bioassays. After exposure to the JFB sediments, plants and animals were harvested and analyzed for contaminants. Laboratory test sediment and tissue concentrations of contaminants were evaluated in relation to field survey collected sediment and plant and animal data for thirteen existing wetland sites around the San Francisco Bay area.

Sediment was collected from the Pinole Shoal and the West Richmond reaches of the John F. Baldwin Ship Channel. Each sediment was collected from core depths to 47 ft (45 ft project depth plus 2 ft overdepth). Sediments were transported to the WES for testing. A field survey of plants, animals and sediments from existing naturally occurring wetland around the San

Francisco Bay Area was conducted to provide a reference data base with which results of the Baldwin sediment testing could be compared.

The naturally-occurring wetlands in the San Francisco Bay area and the adjacent estuarine and freshwater areas contained relatively low levels of most metal, PCB, PAH, butyltin, and pesticides in soil/sediment, plants, and animals. Metals such as lead, chromium and arsenic were elevated in some plants and animals. A very depauperate faunal component in all the naturally-occurring wetlands surveyed may be the result of more subtle impacts then from contamination.

Concentrations of arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium and zinc in John F. Baldwin Ship Channel sediments were in the ranges found in naturally occurring wetlands in the San Francisco Bay area. Butyltin concentrations in Baldwin sediment were less than 5 ppb which is much lower than values in sediments previously tested from the Oakland Inner Harbor turning basin.

The PAH level in sediment from Baldwin - West Richmond reach was above that observed in existing wetland sediments around the San Francisco Bay area and may be of concern. Therefore, further evaluation of this sediment for wetland creation was warranted.

Results of plant bioassays indicated that leaf tissue concentrations of heavy metals were equal to or below those found in the naturally occurring wetlands. Test data suggested a potential for migration of lead from plant tissues into foodwebs associated with the wetland sites. Lead contents of plant tissue in existing wetlands were equal to or higher than guidelines proposed for consumable foodstuff by the World Health Organization (WHO), and may be of concern to the foodwebs associated with these sites. Therefore, the overall status of lead in wetland foodwebs in the area should be monitored and further evaluated.

Plant tissue concentrations of PAHs did not exceed levels found in naturally occurring wetlands, despite being at higher concentrations in the sediment. Therefore, PAHs should not be of concern. Butyltin concentrations

were below concentrations in eelgrass growing in a minimally polluted estuary and, therefore, should not be of concern. Restrictions are generally not required for wetland plants established on Baldwin Ship Channel sediments.

The wetland animal bioassay showed mixed results when both plants and animals were grown in the mesocosms. While Salicornia grew well in the sediments, Spartina foliosa grew poorly, and Scirpus olynei showed the poorest growth. The fall field collection period may have resulted in severe set back into a dormant stage for Spartina and Scirpus. Placing marine sediments in a brackish estuarine wetland resulted in too much salinity for Scirpus to survive. Snails and mussels grew well in the mesocosms. However, the annelids, Nephtys, died in all mesocosms. A thick algae mat formed on all sediment surfaces and tended to seal the surface and eliminate oxygen penetration from tidal water into sediments, suffocating Nephtys. Another sediment dwelling animal will need to be used in future wetland testing.

The wetland mesocosm tests indicated that creating wetlands with J.F. Baldwin Project sediments will produce plants with tissue metal concentrations in the range of those found in existing wetlands in the San Francisco Bay area. The PAH concentrations in Salicornia either in marine or estuarine mesocosms were negligible with only fluoranthene, phenanthrene, and pyrene occurring above detection limits for the Pinole Shoal reach and West Richmond reach sediments. These low levels were similar to those observed for the estuarine reference and a sand control reference. Test data indicated no potential for pesticides to accumulate in wetland plants to concentrations that approach or exceed FDA levels considered for animal feed. No PCBs and butyltin were detected in plants from either the marine or estuarine mesocosms. Test results show elevated ambient arsenic, chromium, and lead, in existing wetlands in the San Francisco Bay area. Placing J.F. Baldwin Project sediments in an estuarine wetland mesocosm showed similar results to the marine mesocosm exposures.

Snails collected from the San Francisco Bay area and exposed to J. F. Baldwin sediments did not accumulate metals above ambient levels or above

reference sediments from existing wetlands. Data indicated that the accumulation of butyltins in wetland animals as shown with mussels should not be of concern when wetlands are created with J.F. Baldwin Project sediments. Data also indicated that PCB uptake by wetland animals should be similar to levels already existing in animals in the San Francisco Bay area and, therefore, should not be of concern. Data suggested that while mussels contained certain PAHs after exposure to Baldwin sediments, the concentrations were more likely due to the relatively high initial tissue background concentration rather than exposure to dredged material.

Pesticide concentrations in mussel tissue were relatively low levels, near detection limits, for all test sediments, for the marine reference, for the sand control reference, and in the initial background tissues of the field collected mussels. These low levels of pesticides do not represent any concern for foodweb contamination in wetlands created with J.F. Baldwin Project sediments.

In summary, test results indicate that wetland creation with J. F. Baldwin Project sediments will produce wetlands comparable to existing wetlands in the San Francisco Bay area. Wetland plants and animals will contain contaminant levels similar to those of existing wetlands. Restrictions on the use of J. F. Baldwin sediments for wetland creation are not required.

Test data suggest the presence of an elevated ambient arsenic, chromium, and lead concentration in existing San Francisco Bay area wetlands. In addition, the field survey indicated few wetland animals present in all naturally occurring wetlands sampled and suggest a more subtle impact such as the prolonged drought and potential increase in wetland salinities.

Use of J. F. Baldwin sediments for brackish wetland creation will require use of more salt tolerant plant species or sufficient leaching of salt from marine sediment prior to the establishment of brackish water wetland plants.

It is recommended that saltwater (marine) wetlands can be created with J. F. Baldwin sediments and should not be a cause for concern. Creation of brackish water (estuarine) wetlands are not recommended since it requires leaching of salt from the marine sediments to allow brackishwater wetland plants to survive and become established. It may take years of tidal flushing to reduce the salinity to a level that will allow brackishwater plants to survive. Additional research is recommended to identify wetland animal species that are sediment-dwellers and can be used for wetland bioassays. Further evaluation is recommended of the ambient elevated concentrations of arsenic, chromium, and lead in existing San Francisco Bay wetlands and the lack of wetland animals present in wetlands.

I. INTRODUCTION

Background

Construction and improvement of the John F. Baldwin Ship Channel were authorized by Congress in the Rivers and Harbors Act of 1965 (Public Law 89-298). The John F. Baldwin Ship Channel is approximately 28 miles long, extending from the San Francisco Bar, through San Pablo Bay, into Carquinez Strait, and onto Sacramento, California. The channel will be maintained at a project depth of -45 ft relative to mean lower low water (MLLW) by dredging and removal of an estimated 800,000 cubic yards (cy) of sediment from the West Richmond reach, 7,000,000 cy from the Pinole Shoal reach and 800,000 cy from Carquinez Strait (Figure I-1).

Sediments were sampled and tested to determine the physical and chemical characteristics of the sediment by Battelle Marine Sciences Laboratory, Seqium, WA. during 1989-1990. Forty seven sites were sampled by coring and geologically described and chemically analyzed (Word and Kohn 1990). Little sediment contamination was found in the John F. Baldwin Ship Channel, except for elevated levels of polycyclic aromatic hydrocarbons (PAHs) in the West Richmond reach and possible elevated levels of trace metals in both Central Pinole Shoal and Carquinez Strait. Because of these bulk sediment chemical analyses, disposal alternatives other than aquatic disposal were evaluated. The disposal environments selected for evaluation were upland disposal and wetland creation. A potential upland disposal alternative was the restoration of levees. Rebuilding of the extensive levee system in the Sacramento/San Joaquin River Delta requires enormous quantities of soil material. In addition, there has been increased public desire in recent years to create and restore wetlands in the San Francisco Bay area in. Dredged material was a potential fill material for levee rebuilding and for wetland creation.

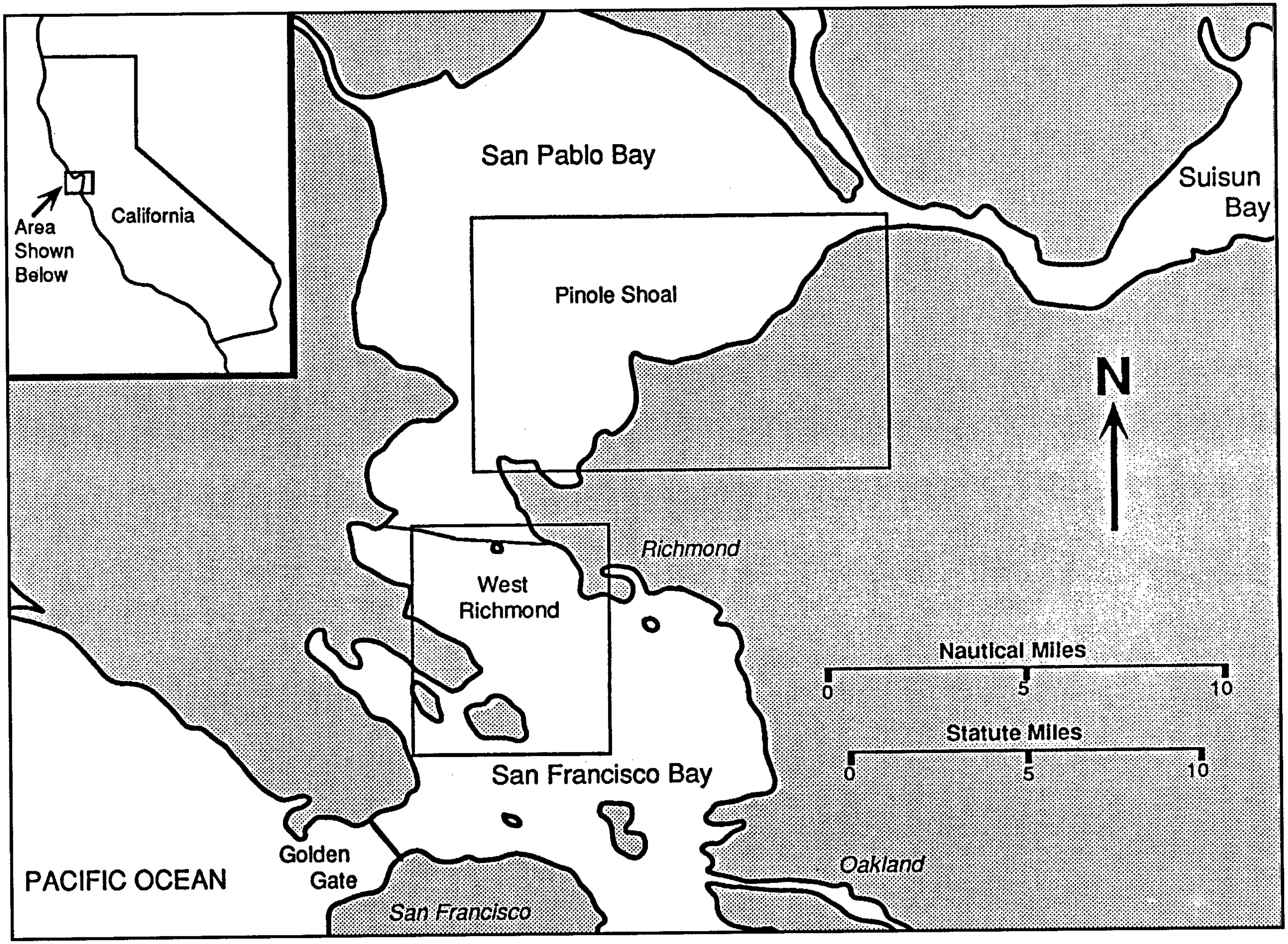


Figure I-1. John F. Baldwin Ship Chanel Study Reaches

The U. S. Army Engineer Waterways Experiment Station (WES) was asked to assist in the evaluation of other alternatives, such as upland disposal and wetland creation, for these sediments. Francingues et al. 1985 and Lee et al. 1991 described the Corps' Management Strategy for Disposal of Dredged Material, in which a sediment is tested and evaluated for potential disposal site environments, including aquatic, wetland and upland. These test protocols are used in the present evaluation to determine the potential for migration of contaminants into plants and animals under a wetland creation environment.

The Corps' management strategy has been applied in total or in part to the following dredging projects:

Everett Homeport Project, WA
Black Rock Harbor, CT
Indiana Harbor, IN
Blue River Project, Kansas City, MO
New Bedford Harbor, MA
Baltimore Harbor, MD
Southwest Pass, LA
Corpus Christi Harbor, TX
Bridgeport Harbor, CT
Oakland Harbor, CA
Duwamish Waterway, WA
Michigan City Harbor, IN
Detroit River, MI
Menominee River, WI
Milwaukee Harbor, WI
Times Beach CDF Site, Buffalo, NY
Toledo Harbor CDF, Toledo, OH
Benton Harbor, MI
Acid Mine Spoil Restoration, Ottawa, IL
Dike 12 CDF, Cleveland, OH
Lock and Dam 2, St. Paul, MN
Pointe Mouillee, MI
Broekpolder, Rotterdam, The Netherlands
Hamlet City Lake, Hamlet City, NC

The Corps' management strategy test protocols have also been applied to a number of other contaminated sites such as:

Naval Weapons Station, Concord, CA
Naval SUBASE, Bangor, WA
PCB Spill Site, Delft, The Netherlands
Metal Mining Waste Sites, Wales, United Kingdom
Agricultural Sites, Haren, The Netherlands
Wetland Sites, Eastern Scheldt, The Netherlands
Sewage Sludge Amended Soils, Beltsville, MD
Roadside Contamination Sites, Chicago, IL
Agricultural Sites, Montepellier, France
Wetland Sites, Lisbon, Portugal

Test results have been used to evaluate potential contaminant migration and to formulate management strategies and/or remedial actions at these sites.

Purpose and Scope

The purpose of this report is to describe the results of a comprehensive evaluation of the impact of placing the John F. Baldwin Ship Channel sediment in a wetland environment. The evaluation considered contaminant pathways that would occur at a wetland creation site. Contaminant migration via plant and animal uptake was evaluated. Contaminants of concern were salt, metals, tributyltin (TBT), and polycyclic aromatic hydrocarbons (PAHs). Test results were evaluated in relationship to contamination observed in existing wetland sites within the San Francisco Bay area.

The interpretation of the results of biological and chemical testing of a sediment to evaluate its potential use in wetland creation requires a yard-stick (i.e. reference database) for comparison. For this reason, naturally-occurring wetlands in the San Francisco Bay area were identified and the soil/sediment and the indigenous plant and animal communities were sampled. In coordination with personnel of the USACE San Francisco District, sites were that are considered to be typical undisturbed wetlands by the Corps of Engineers District, and by Federal and State resource agencies selected. Unfortunately, since settlement, the San Francisco Bay Area has been the source of anthropomorphic disturbance that has resulted in both modification of the landscape and the introduction of numerous plant and animal species. As a result, locating the desired species or a sufficient biomass of the desired species for analysis is not always possible. During the summer of 1990, when the following survey was conducted, animal species, live populations of bivalve mollusks in particular, were not present in either the marine or estuarine wetlands. The paucity of animals has certainly limited the comparative value of the following survey. However, the plant and sediment/soil data provide for comparison with the species employed in the mesocosm test procedures.

Test data will be discussed in terms of statistical differences. Statistical differences were measured at the $P = 0.05$ level of significance, unless otherwise noted, using standard procedures that consider variability in test data to separate means. The use of the words "significant" and/or "substantial" increase or amount describes the magnitude of an increase or amount and will be interpreted in this report to mean that such an increase or amount is important ecologically.

Objectives

The objectives of this study were to address the following questions:

1. Will the sediments from West Richmond and Pinole Shoal Reaches be toxic to and/or result in the contamination of wetland plants?
2. Will the sediments from West Richmond and Pinole Shoal Reaches be toxic to and/or result in contamination of wetland animals?
3. How do test results compare to the levels of contaminants in sediments, plants and animals in existing wetlands near proposed wetland creation sites?

Approach

The experimental design for the laboratory tests included two plant species, *Spartina alterniflora* and *Sporobolus virginicus*, and three sediments with four replicates for the plant bioassay. Three animals, *Nassarius* (mud dogwhelks), *Nepthys* (annelids), and *Modiolus* (ribbed mussels) and three local plant species, *Spartina foliosa* and *Salicornia subterminalis* were used for saltmarsh mesocosms and *Scirpus olynei* and *Salicornia subterminalis* were used for the brackish wetland mesocosms with three replicates for the wetland animal bioassays. After exposure to the JFB sediments, plants and animals were harvested and analyzed for contaminants. Laboratory test sediment and tissue concentrations of contaminants were evaluated in relation to sediments, plants, and animals data for thirteen existing wetland sites around the San Francisco Bay area.

II. SEDIMENT CHARACTERIZATION

Methods and Materials

Sediment Collection, Transport, and Mixing. Sediment was collected from the Pinole Shoal and the West Richmond reaches of the John F. Baldwin Ship Channel (Figures II-1, and II-2) using a 12-inch diameter split core sampler (See Appendix A for further details). Each sediment was collected from core depths to 47 ft (45 ft project depth plus 2 ft overdepth) and composited into 15 55-gal barrels for the West Richmond reach or into eight 30 gallon barrels for the Pinole Shoal reach and labelled according to reach. Pinole Shoal reach was divided into two composite sediments. One composite contained four barrels of sediment from sample locations PIC through PVIIIR (PSC2), while the other composite consisted of four barrels of sediment from PXIL to PXIVC (PSC3) (Figure II-2).

All barrels of collected sediments were loaded into a refrigerated truck and transported to the WES. The barrels were placed in a 4°C cold storage room for 5 days prior to mixing.

Barrels of the West Richmond reach sediment were removed from the cold storage room and poured into a lined 4x15x4 feet soil bed lysimeter (Figure II-3). The sediment was mixed by hand with shovels and mechanically with a lightning mixer (Figures II-4 and II-5). After mixing, subsamples were randomly collected from the entire soil bed for use in either the wetland plant or animal test apparatus (Figures II-6 and II-7). Mixed sediment samples were containerized and stored in a cold (4°C) storage facility until used (Figures II-8 and II-9). The 30 gallon barrels of each composite sediment from the Pinole Shoal reach were mixed within each barrel using a lightning mixer. Subsamples of mixed sediment were placed in either the wetland plant or animal test apparatus.

Sediment mixing was evaluated by collecting aliquot samples from each barrel labelled for each upland test or the soil bed after the mixing process. After mixing all barrels of sediment as shown in Figures II-3 through II-7, subsamples were collected for use in separate tests of the plant bioassay

(PL), and the animal bioassay (AC). Another aliquot of sediment was collected from each container for analysis of %sand, copper, total organic carbon (TOC), and texture. The uniformity of sediment to be used by the separate wetland tests was evaluated.

Sediment Physical Characterization. Sediment samples were tested for the following engineering properties: liquid limits, plastic limits, void ratio, water content, density, particle size distribution, consolidation and settling (Engineer Manual 1110-2-5027, U.S. Army Corps of Engineers 1987).

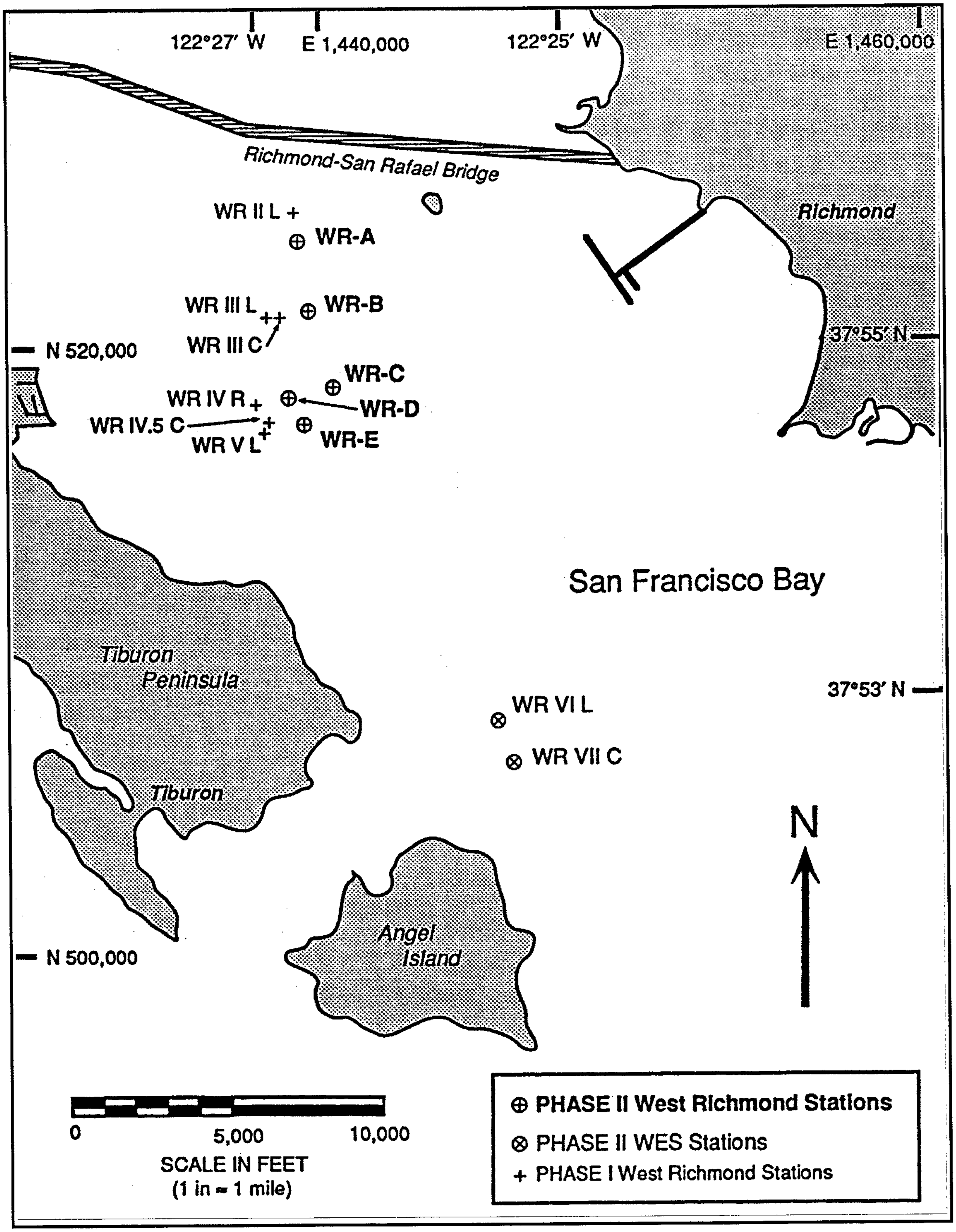


Figure II-1. Location of West Richmond Reach Sampling Stations

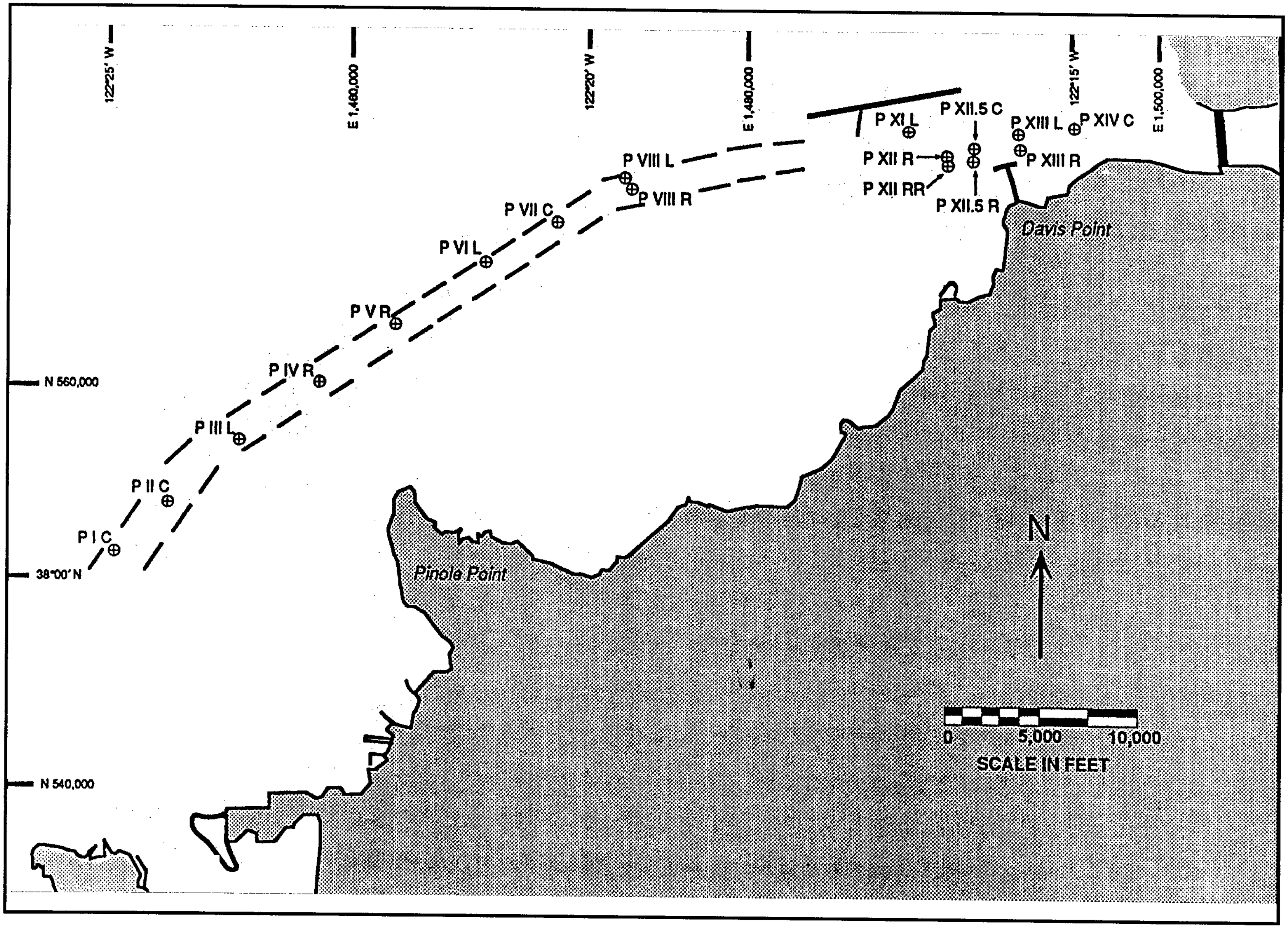


Figure II-2. Location of the Pinole Shoal Reach Sampling Stations

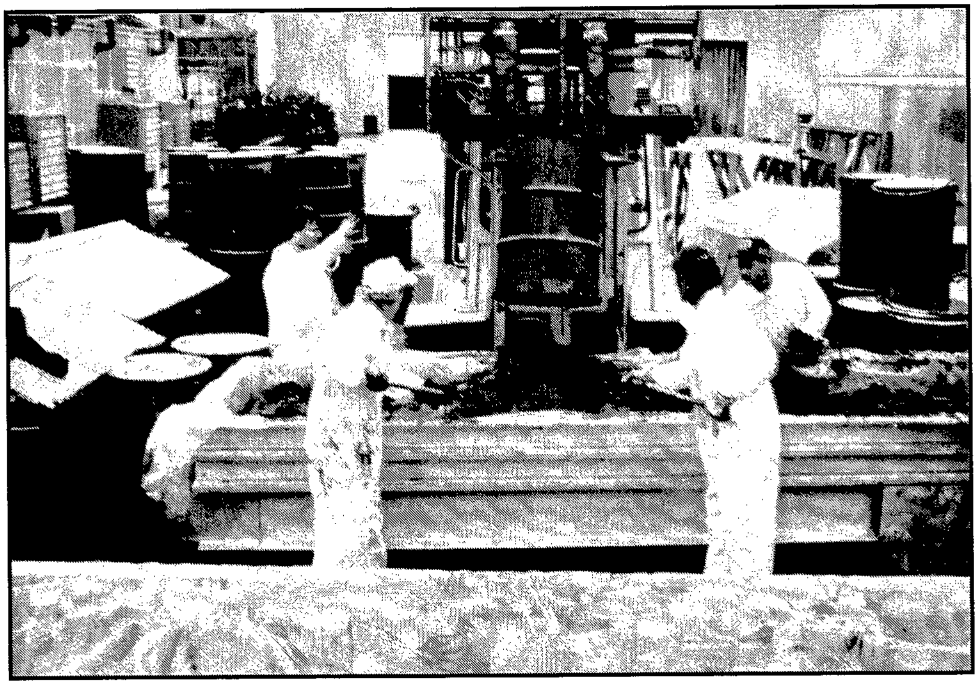


Figure II-3. Barrels Were Emptied Into Soil Bed Lysimeter For Mixing

Figure II-4. Sediment Was Mixed Manually With Shovels, Rakes and Hoes

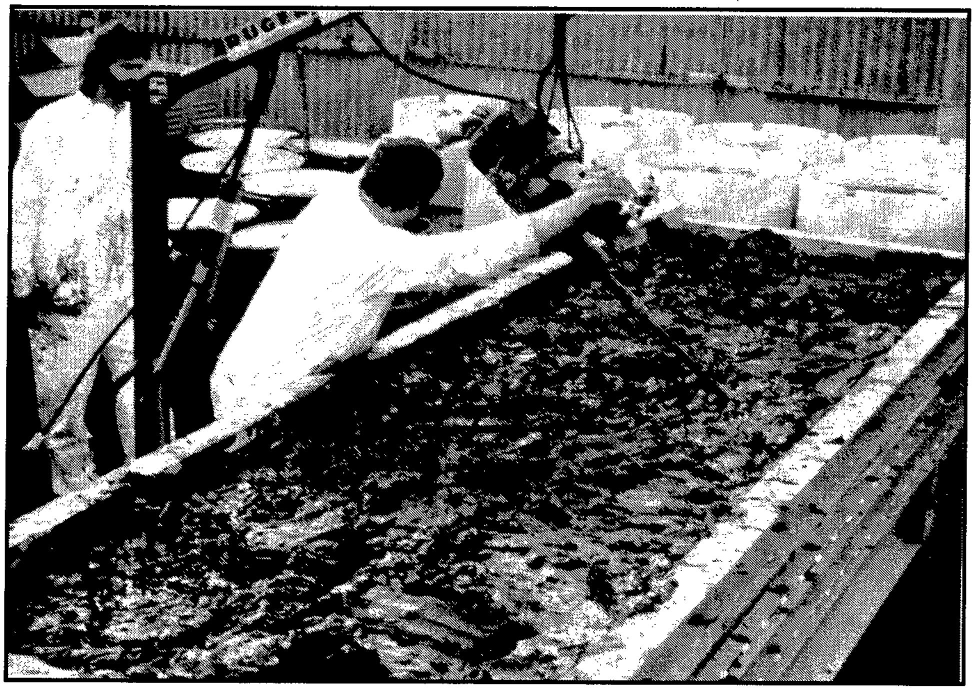


Figure II-5. A Lightning Mixer Was Used To Thoroughly Mix Sediment

Figure II-6. Random Samples Were Removed From the Soil Bed Lysimeterand Placed in Barrels

Figure II-7. Additional Samples Were Randomly Collected From All Sections of the Soil Bed Lysimeter For Individual Tests

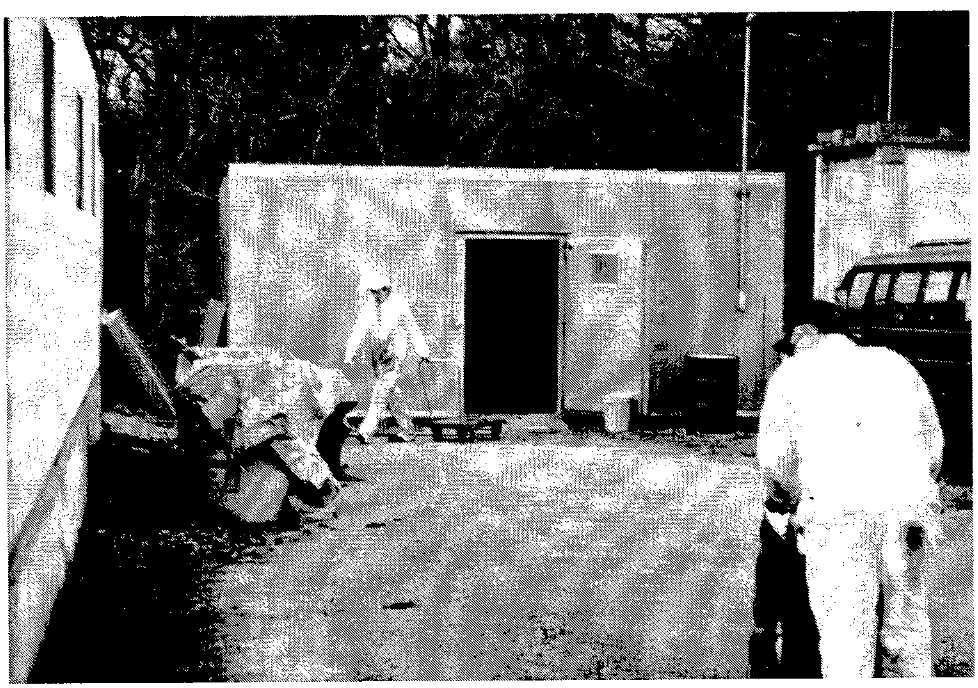


Figure II-8. Mixed Sediments Were Collected in Barrels and Taken To a Refrigerated Building

Figure II-9. Barrels of Mixed Sediment Were Placed in a Refrigerated Room at 4 Degrees Celsius Until Tested

Sediment and Soil Characterization. Sediment and soil samples were shipped to Dr. Eric Crecelius at Battelle Marine Sciences Laboratories, Sequim, WA for the chemical analyses. Analytical methods and references are described in Appendix A. They were similar to the methods discussed in Lee et al. 1992a. Baldwin sediments were analyzed for 10 metals (silver, arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc), 4 butyltins (tetrabutyltin, tributyltin, dibutyltin, and monobutyltin), and 15 polycyclic aromatic hydrocarbons (PAHs). All data received from the analytical laboratory are presented in Appendix A.

Results and Discussion

Adequacy of Mixing Composite Sediment. Sediment mixing was evaluated by collecting aliquot samples from each barrel labelled for each upland test or the soil bed after the mixing process. The coefficients of variation were below 10 percent in all parameters except total organic carbons and percent

sand which were 50.09% respectively, for Pinole Shoal sediments (Table II-1). The coefficients of variation was above 10% in TOC for the W. Richmond sediment (Table II-1). Coefficients of variability of 10% or less are observed in well-controlled experimentation. Since TOC values are large numbers (in the thousands), large coefficients of variability are not unusual.

Sediment Physical Characterization. Pinole Shoal and W. Richmond sediment textures were sandy clay (CH) and clayey silty sand (SM), respectively. Physical properties are shown in Figures II-10 and II-11 for Pinole Shoal and W. Richmond, respectively. Additional engineering properties for consolidation and settling are included in Appendix A.

Sediment and Soil Chemical characterization. Results of the chemical analyses of John F. Baldwin Ship Channel sediments are shown in Tables II-2 (metals), II-3 (metals QA/QC), II-4 (butyltins), II-5 (PAHs), II-6 (PAH method blank values).

Bulk chemical analysis data for sediments give an inventory of the presence of contaminants. These data can be compared to bulk chemical analysis data for potential disposal site sediments or soils, and/or to available information or literature that give perspective and/or guidance on acceptable levels of contaminants in soils/sediments for specific uses. An example of bulk chemical analysis data that could be used for comparison is soil/sediment data from the field survey of naturally existing wetlands in the San Francisco Bay area conducted as part of this study. These comparisons will indicate whether the dredged material contains concentrations of contaminants lower than, equal to, or higher than the respective referenced data and will indicate whether there is reason to believe the dredged material is contaminated and further testing is prudent.

Although a few of the Pinole Shoal sediment metals are elevated, none of these metal concentrations are unusually high (Table II-2). The metals As, Cr, Cu, and Ni are elevated (more than 2 times) in comparison to the metals

found in representative reference sediments (Tatem 1990). However, these values are not unusually high. An example of a sediment with unusually high metals concentrations is the CE/EPA Field Verification Program (FVP) sediment from Black Rock Harbor (Brandon et al. 1991). All sediments contain metals that vary in concentration from site to site. Unless a metal is very high in comparison to reference or disposal site sediments, or is present in phytotoxic concentrations, the best way to evaluate potential for environmental problems is to conduct laboratory studies such as leachate, runoff, and plant and animal bioassays. Metal concentrations thus obtained can be compared to the field survey data (Table II-3) for representative sediments around the San Francisco Bay area. This comparison puts the test sediment contamination level in perspective to existing naturally occurring environmental conditions for the San Francisco Bay area. Sediment metal concentrations were in the range found in existing wetlands in the San Francisco Bay area sampled during the field survey (Table II-3). An exception was be the low chromium concentrations found in Pinole Shoal sediments PSC2 and PSC3.

The butyltins were very low: 1.1 ppb for tributyltin and < 1 ppb for dibutyltin (Table II-4). These are less than concentrations found in the field survey for sediments collected from the San Francisco Bay area (Table II-3). Few specific guidelines for evaluating butyltins in sediments exist. However, since these concentrations are less than those in other references, there is no reason to believe that they represent environmentally unsafe levels.

Baldwin - West Richmond sediment contained a level of PAHs that may be of concern (Table II-5). Reference sediments did not contain detectable levels of PAHs (Tatem 1990). Typical PAH contaminated sediments may contain 25,000 ppb or more of total PAHs, concentrations which are approximately six times higher than West Richmond sediment. Sediment PAH concentrations found in the field survey (Table II-3) indicated that most values were below 200 ppb. West Richmond sediment contained certain PAHs (phenanthrene,

fluoranthene, pyrene, benzo(a)anthracene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and benzo(g,h,i)perylene) above 200 ppb which indicates potential concern. Therefore, further evaluation of this sediment for wetland creation was warranted. Table II-6 contains PAH method blank values for the data shown in Table II-4. All PAHs were shown to be less than the low ppb detection limits.

Table II-1

Variability of Selected Sediment Parameter Data After Mixing

Pinole Shoal Sediment

SAMPLE NO.	Copper	TOC	% Solids	% Sand
PS-C4-ACALG	36.1	1780	62	29
PS-C4-LABALG	40.1	1860	63	29
PS-C4-LEALG	42.6	2540	63	25
PS-C4-PLALG	42.0	5210	60	26
PS-C4-ELALG	39.7	1780	59	17
Mean	40.1	2634	61	25
Std. Dev.	2.28	1319	1.6	4.4
Coeff. of Var.	5.69	50.09	2.65	17.46

West Richmond Sediment

SAMPLE NO.	Copper	TOC	% Solids	% Sand
WR-PL-ALG	18.1	4870	69	53
WR-LAB-ALG	21.0	1400	66	48
WR-EL-ALG	20.9	1340	69	54
WR-AC-ALG	18.3	1640	78	60
WR-LE-ALG	18.8	2210	69	62
Mean	19.4	2292	70	55
Std. Dev.	1.27	1325	4.1	5.0
Coeff. of Var.	6.54	57.82	5.80	9.10

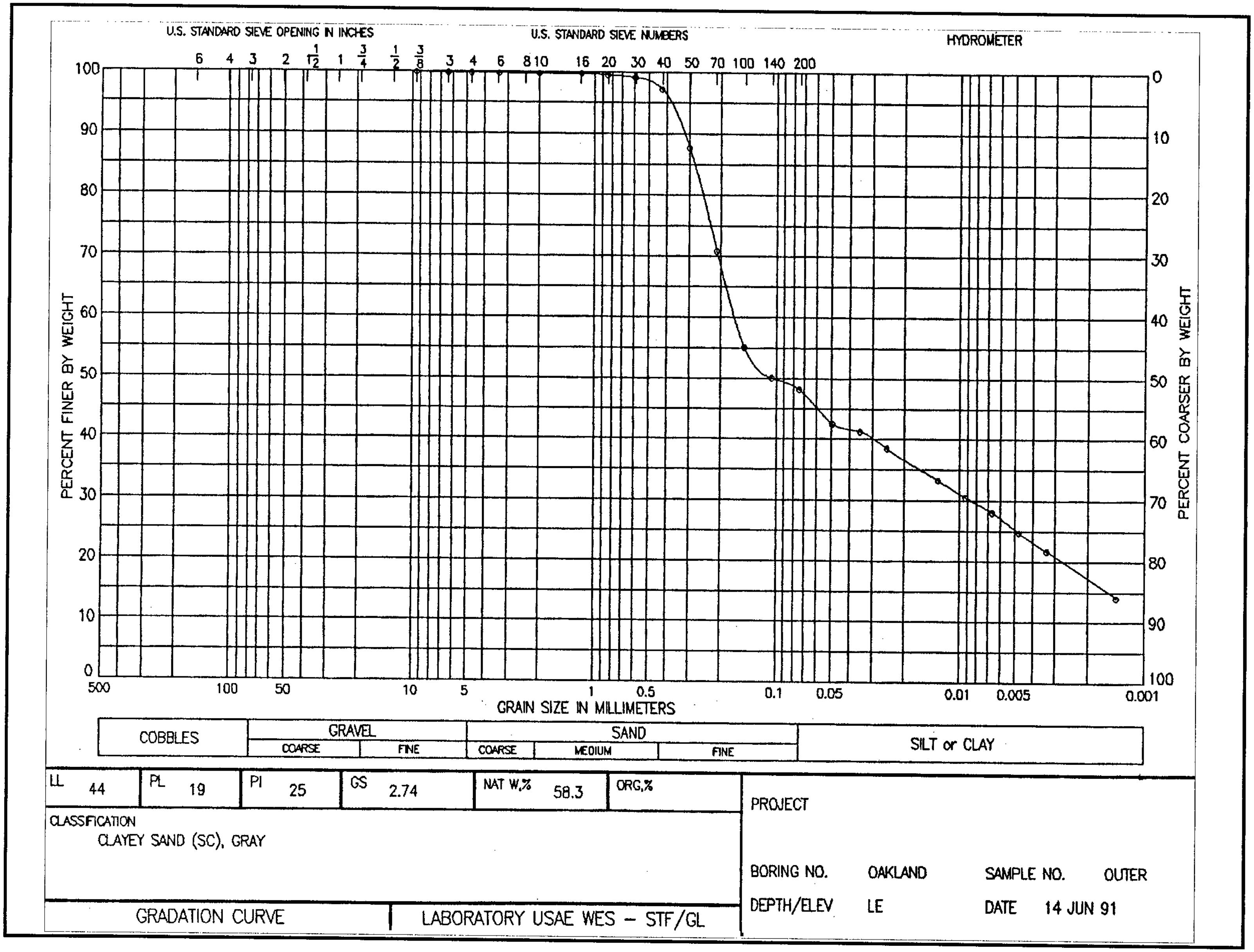
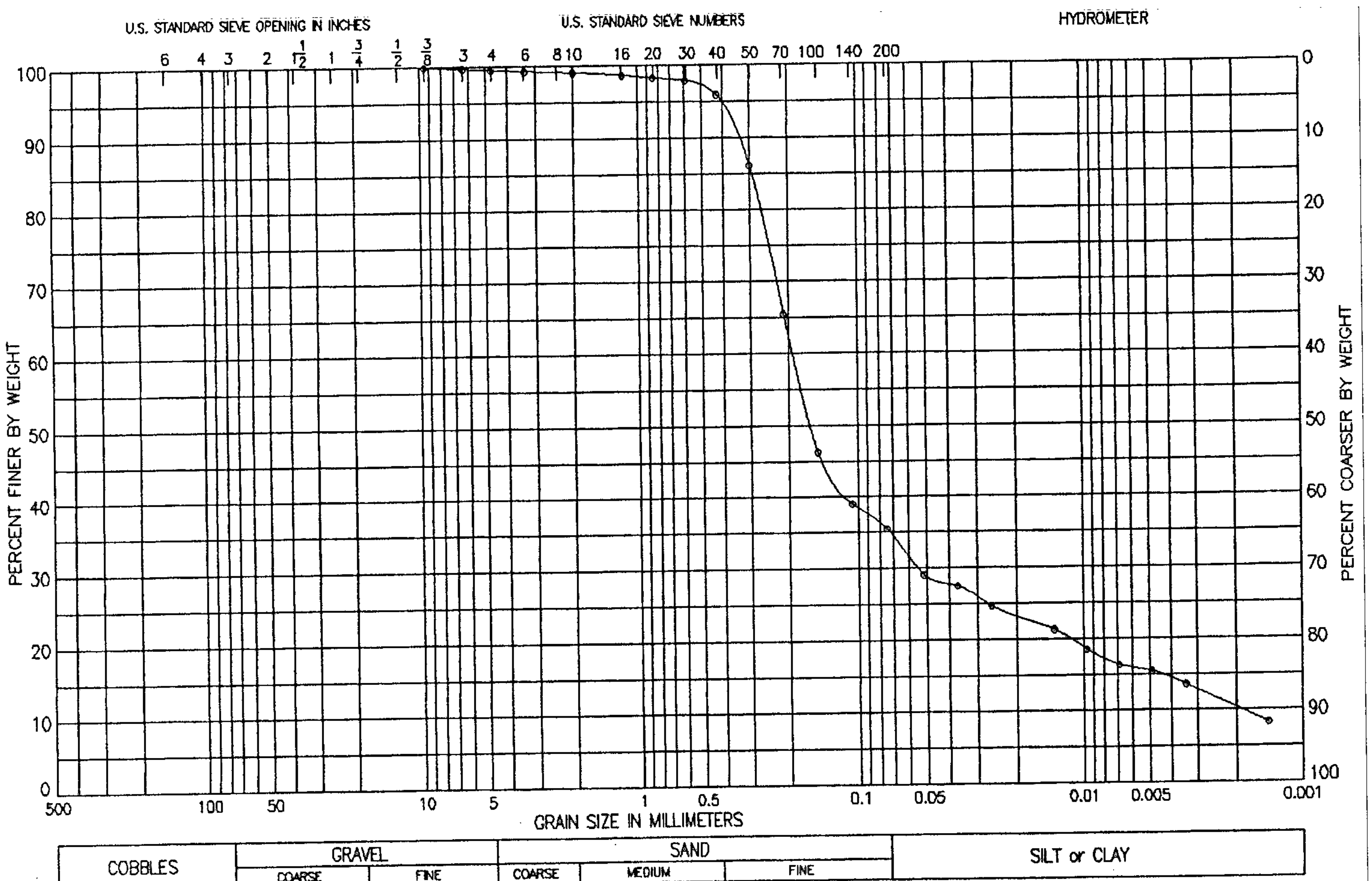


Figure II-10. Physical Engineering Properties of Pinole Shoal Sediment



LL 27	PL 16	PI 11	GS 2.74	NAT W,% 38.9	ORG,%

CLASSIFICATION
CLAYEY SAND (SC), GRAY

PROJECT

BORING NO. OAKLAND SAMPLE NO. INNER

DEPTH/ELEV LE DATE 14 JUN 91

GRADATION CURVE | LABORATORY USAE WES - STF/GL

Figure II-11. Physical Engineering Properties of W. Richmond Sediment

Table II-2

Mean Concentrations of Metals in J.F. Baldwin Sediments

Parameter	Concentrations (mg/kg dry weight)				
	Baldwin Pinole C4 *	Baldwin W. Rich	Baldwin W. Rich AD	Baldwin + Pinole C2	Baldwin + Pinole C3
Silver / Ag	0.092 (.018) **	0.118 (.039)	0.707 (1.21)	<0.166 (0.00)	<0.284 (0.128)
Arsenic / As	13.760 (2.61)	9.600 (1.21)	6.227 (0.152)	7.408 (0.235)	10.058 (0.054)
Cadmium / Cd	0.272 (.018)	0.270 (.020)	0.046 (8.50)	0.113 (0.076)	<0.035 (0.035)
Chromium / Cr	210.2 (33.8)	206.0 (26.9)	26.684 (2.984)	36.318 (2.841)	30.660 (1.141)
Copper / Cu	49.40 (3.14)	28.40 (3.07)	18.061 (0.343)	32.755 (0.632)	33.332 (0.260)
Mercury / Hg	0.238 (.095)	0.164 (.024)	0.140 (2.285)	0.121 (0.013)	0.381 (0.027)
Nickel / Ni	94.60 (6.27)	78.40 (2.79)	41.990 (3.021)	60.406 (1.957)	48.605 (1.168)
Lead / Pb	18.88 (10.2)	14.48 (0.57)	16.25 (3.143)	22.512 (1.172)	25.039 (0.734)
Selenium / Se	0.182 (.063)	0.144 (.006)	<0.204 (0.000)	<0.330 (0.000)	<0.310 (0.000)
Zinc / Zn	92.60 (4.72)	78.60 (3.36)	45.561 (3.242)	60.450 (4.729)	61.123 (2.361)

* Composite of entire Pinole Shoal reach, PSC4
** values shown in parentheses are standard deviations
\+ PSC2 and PSC3 were additional samples collected separately from PSC4 and analyzed at the WES ALG.

Table II-3

Concentrations of Metals in a Standard Reference Material Analyzed by the Analytical Laboratory - Battelle Marine Sciences Laboratories

Parameter	Concentrations (mg/kg dry weight)	
	OW - S	SRM - Certified Value
Silver / Ag	0.09	NA *
Arsenic / As	11.0	11.6
Cadmium / Cd	0.32	0.36
Chromium / Cr	68.0	76.0
Copper / Cu	20.1	18.0
Mercury / Hg	0.078	0.063
Nickel / Ni	34.3	32.0
Lead / Pb	26.8	28.2
Selenium / Se	0.54	(0.6) **
Zinc / Zn	131.3	138.0

* NA - Not Analyzed
** Values in parentheses are not certified

TABLE II-4

Mean Concentrations of Butyltins in J.F. Baldwin Sediments

Parameter	Concentrations (ug/kg dry weight)				
	Baldwin Pinole C4 *	Baldwin W. Rich	Baldwin W. Rich AD	Baldwin Pinole C2 +	Baldwin Pinole C3 +
Tetrabutyltin	< 0.8 (0.00)	< 0.9 (0.00)	< 0.475 (0.05)	< 0.63 (0.02)**	< 0.55 (0.03)
Tributyltin	1.17 (0.18)	1.14 (0.15)	0.55 (0.06)	1.32 (0.52)	0.97 (0.11)
Dibutyltin	0.70 (0.06)	0.70 (0.07)	< 0.475 (0.05)	0.97 (0.26)	< 0.55 (0.03)
Monobutyltin	< 0.7 (0.00)	< 0.8 (0.00)	1.125 (1.45)	< 0.63 (0.06)	< 0.50 (0.00)
TOTAL	3.37	3.54	2.63	3.55	2.57

* Composite of entire Pinole Shoal reach, PSC4
** values shown in parentheses are standard deviations
\+ PSC2 and PSC3 were additional samples collected separately from PSC4

TABLE II-5

Mean Concentrations of PAHs in J.F. Baldwin Sediments

Parameter	Concentrations (ug/kg dry weight)				
	Baldwin Pinole C4*	Baldwin W. Rich	Baldwin W. Rich AD @	Baldwin Pinole C2 +	Baldwin Pinole C3 +
Naphthalene	< 27.4	< 32.6	< 39.2 (0.6)	6.0 (0.4)	6.3 (0.5)
Acenaphthylene	< 4.2	13.98	53.5 (17.6)	< 5.5 (0.2)	< 5.6 (0.1)
Acenaphthene	< 10.4	14.10	44.9 (11.9)	< 5.5 (0.2)	< 5.6 (0.1)
Fluorene	< 8.3	15.76	51.1 (24.5)	< 5.5 (0.2)	< 5.6 (0.1)
Phenanthrene	14.14	289.60	528.1 (278.1)	7.4 (0.5)	8.8 (1.2)
Anthracene	< 4.9	57.40	144.9 (94.2)	< 5.5 (0.2)	< 5.6 (0.1)
Fluoranthene	10.80	407.80	615.2 (361.2)	9.0 (1.2)	20.4 (3.5)
Pyrene	13.80	513.80	826.7 (302.2)	11.6 (2.0)	26.5 (4.9)
Benzo(a)anthracene	14.12	259.80	364.4 (147.9)	< 5.5 (0.2)	10.1 (1.9)
Chrysene	5.80	170.30	276.0 (89.2)	< 5.5 (0.2)	10.5 (2.0)
Benzofluoranthenes **	13.02	582.40	533.5 (163.7)	< 12.2 (1.1)	27.9 (5.7)
Benzo(a)pyrene	6.28	466.20	759.1 (258.7)	7.7 (1.6)	18.2 (3.5)
Indeno(1,2,3-c,d)pyrene	5.98	316.60	327.1 (79.3)	7.1 (1.2)	12.6 (3.1)
Dibenzo(ah)anthracene	< 3.8	48.92	47.7 (9.2)	< 5.5 (0.2)	< 5.6 (0.1)
Benzo(g,h,i)perylene	9.98	496.60	415.7 (79.3)	8.3 (1.6)	15.8 (3.8)
TOTALS	152.9	3685.9	5027.1	107.8	127.2

* Composite of entire Pinole Shoal reach, PSC4
** all benzofluoranthene isomers (b,j and k) are quantified together
\+ PSC2 and PSC3 were additional samples collected separately from PSC4
@ these compounds identified in the analysis at a secondary dilution factor

TABLE II-6

PAH Method Blank Values for J.F. Baldwin Sediments

Parameter	Concentrations ug/kg dry weight			
	Baldwin Pinole C4*	Baldwin W. Rich	Baldwin Pinole C2	Baldwin Pinole C3
Naphthalene		<1.50		
Acenaphthylene		<0.22		
Acenaphthene		<0.56		
Fluorene		<0.44		
Phenanthrene		<0.59		
Anthracene		<0.26		
Fluoranthene		<0.37		
Pyrene		<0.28		
Benzo(a)anthracene		<0.26		
Chrysene		<0.22		
Benzofluoranthene		<0.28		
Benzo(a)pyrene		<0.22		
Indeno(1,2,3-c,d)pyrene		<0.35		
Dibenzo(ah)anthracene		<0.20		
Benzo(g,h,i)perylene		<0.18		

III: PLANT TEST

Methods and Materials

Sediment Preparation. Upon arrival at the WES, the PSC2 and PSC3 sediments were each placed in a walk-in cold room at 4°C until testing began. The West Richmond reach sediment was placed into a soil lysimeter and thoroughly mixed. Enough sediment was randomly collected from the lysimeter to fill one 208-L (55-gal) steel barrel, labeled PL, for the plant test. One sample was collected from this barrel for wet sediment analysis of heavy metals, PAH and butyltins. The barrel of sediment was stored in the cold room to await further preparation.

The PSC2 and PSC3 sediments were removed from the cold room and dumped from the 30-gal barrels into separate aluminum drying flats, Figure III-1. The WES Reference soil was also dumped into a drying flat. Each sediment was thoroughly mixed and three 19.0-L samples were immediately collected and placed in new, high density polyethylene buckets with sealed lids. These were placed back in cold storage to await initiation of the wetland test. Samples for chemical and physical analysis were also collected and placed in new glass bottles with teflon lined lids. The remaining sediment was placed back into barrels and stored in the cold room.

The barrel of WRC1 sediment was removed from the cold room and dumped into an aluminum drying flat in an environmentally controlled greenhouse. After thorough mixing, three 19.0-L samples were collected and placed in new, high density polyethylene buckets with sealed lids. These were placed into the cold room for the wetland test; the remainder would be used in the upland portion of the plant test.

Figure III-1. Sediment Placed in an Aluminum Drying Flat to be Thoroughly Mixed Prior to the Wetland Plant Bioassay Test.

The WES reference soil (WRS1) was a silt loam collected from an undisturbed woodland area at the WES and was used as a control for the wetland test. The air-dried soil was placed in three 19-1 polyethylene buckets and flooded for 28 days. The sealed buckets of flooded WRS1 were placed in the cold room with the three test sediments.

Preparation of Greenhouse Tests. A schematic diagram of the standard WES plant bioassay apparatus is shown in Figure III-2. Four wetland replicates of each sediment (to be planted with *Spartina alterniflora*), were prepared by placing 4500 g (ODW) of sediment (one 500-ml scoop at a time) into each prepared 7.6-1 Bain Marie container. Four seedlings of *Spartina alterniflora* were planted in each replicate. Reagent grade nitrogen, phosphorus and potassium were added to the WRS1 to provide the minimum nutritional requirements for optimum growth.

In addition, 4 replicates of two additional WRS1 treatments were prepared for the growth of *Spartina alterniflora*. One replicate set was maintained in a flooded condition with freshwater and the second replicate set was maintained in an upland condition. These two additional treatments were added for yield comparisons only and were not analyzed for contaminant uptake.

Greenhouse Operation and Growing Techniques. The replicates were randomly placed on tables in the greenhouse. Day length of 16 hrs was maintained by using light fixtures whose face was 130 cm from the top of the 22.7-L buckets. The 130-cm height allowed maximum potential plant growth to occur without damage from the heat produced. Lights were arranged in a pattern of alternating high pressure sodium lamp and a high pressure multi-vapor halide lamp. Alternating the lamps provided an even photosynthetic active radiation (PAR) distribution pattern of 1200 uEinsteins/m^2/sec. The temperature of the greenhouse was maintained at 32.2 $\pm$ 2° C maximum during the day and 21.1 $\pm$ 2° C minimum at night to simulate a summer environment. Relative humidity was maintained as close to 100% as possible, but never less than 50%. Each treatment (except the two additional WRS1 controls) was maintained in a flooded condition by adding an Instant Ocean/reverse osmosis (RO) water solution of 15 parts per thousand (ppt).

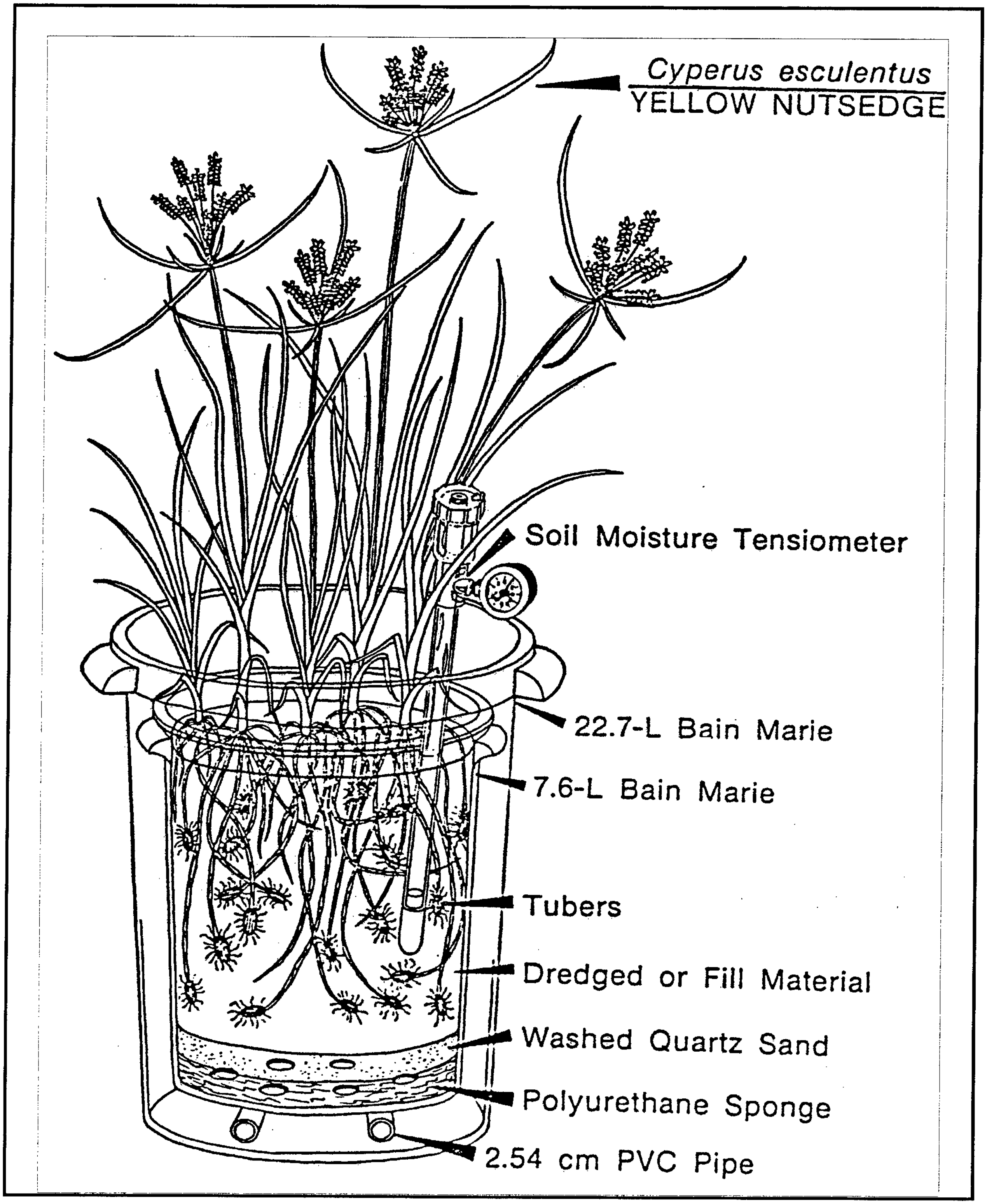


Figure III-2. Plant Bioassay Apparatus.

Plant Tissue Collection and Preparation. After 90 days, *Spartina alterniflora* was harvested from each container. Stainless steel scissors were used to cut the plant tissue 5 cm above the sediment/soil surface (Figure III-3). The tissue was immediately washed in distilled water to remove any salt, sediment or dust particles and blotted dry. Total fresh weight of each replicate was determined. Some of the replicates were combined when necessary to provide sufficient tissue mass for contaminant analyses. Plant tissue from replicates or combined replicates were split for heavy metals, butyltins, and PAH analyses. The portion for butyltins and PAHs was placed in a glass bottle with teflon closure and frozen. The heavy metals portion was dried to constant weight at 70° C in a forage drying oven to determine percent plant moisture and yield. After drying, the tissue was ground in a small Wiley mill or,for very small samples, with a mortar and pedestal for very small samples. The ground tissue was placed in polyethylene bottles until analysis.

Electrical Conductivity. Electrical conductivity (EC) was determined on saturated extracts of each sediment using the method of Rhoades (1982). The extracts were measured on a YSI model 32 conductance meter to determine EC in mmhos/cm. EC was also determined on original wet test sediment and WRS1.

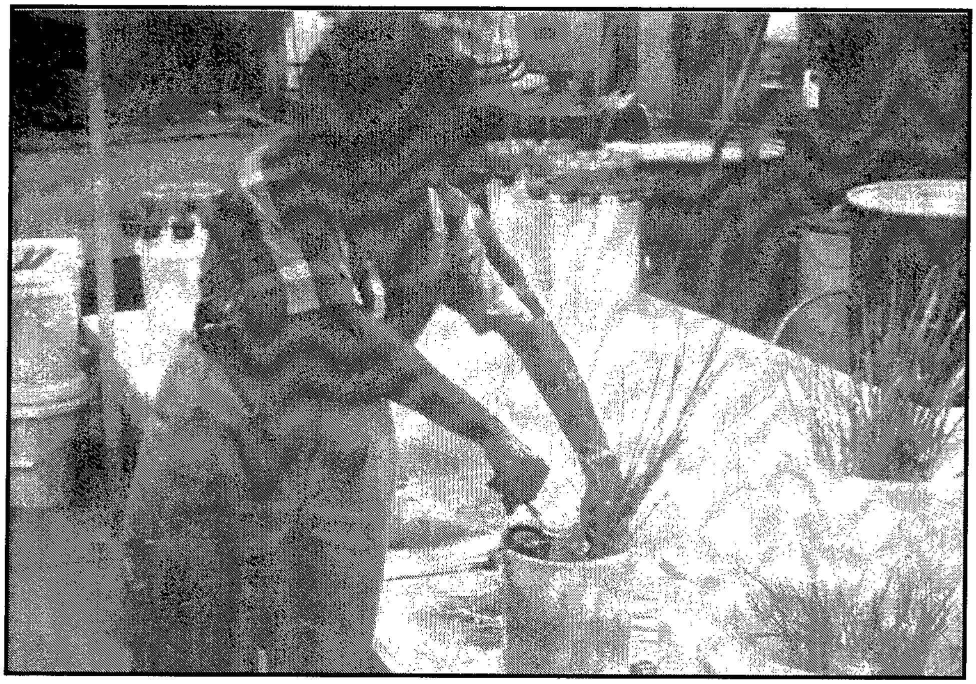


Figure III-3. Harvesting Plants After Growing in Various Substrates

Sediment pH. Ten grams (ODW to nearest 0.001 g) of each sediment were weighed into a tall 50-ml Pyrex glass beaker. Twenty ml of distilled water were added and the mixture was stirred with a polyethylene rod until all particles were saturated. The mixture was stirred with a magnetic stirrer for 1 min every 15 min for 45 min. After 45 min, the pH electrode was placed into the solution above the surface of the sediment and the pH was read on a pH meter (Folsom, Lee and Bates 1981).

Organic Matter. Organic matter (OM) was determined by weight loss on ignition at 550° C on each sediment. Procedure No. 209E (American Public Health Association 1976) was used for this test. A 5-g subsample (ODW) was weighed to the nearest 0.001 g and dried at 105 $\pm$ 2° C until constant weight (48 hr). Five grams of the oven-dried sediment is weighed to the nearest 0.001 g and combusted at 550 $\pm$ 5° C for 24 hr in a muffle furnace. The sample was allowed to cool to room temperature in a desiccator and reweighed to the nearest 0.001 g. Weight loss on ignition was calculated and reported as % OM using the following equation:

$$\%OM = \frac{\text{weight oven-dry sediment} - \text{weight combusted sediment}}{\text{weight oven-dry sediment}} \times 100$$

Particle Size Analysis. Particle size was determined on PSC2 and PSC3 sediments only using the method of Day (1956) as modified by Patrick (1958).

Sediment Digestion and Heavy Metals Analysis. Sediment heavy metal concentrations were determined on each test sediment and National Bureau of Standards Reference Material (NBS) 1646. The WRS1 sediment was analyzed for contaminants in the upland test. One gram (ODW) (weighed to the nearest 0.001 g) sediment was placed in a 120-ml Teflon PFA vessel. Ten ml of concentrated nitric acid was added and the cap was placed on the vessel and sealed at 12 ft lb of torque. Ten sample vessels, one NBS 1646, and one acid

blank were placed in a digestion turntable and venting tubes were attached. The turntable was placed in a MDS-81-D microwave digestion unit (CEM Corporation, Matthews, NC), set into 360° rotation, and heated at 600 W for 2 min 30 sec and then 480 W for 10 min. After cooling to room temperature, each vessel was hand vented under a hood to release pressure and uncapped. Five ml of 30% hydrogen peroxide was added and allowed to effervesce. When the effervescence stopped, the solution was quantitatively filtered through a Whatman # 41 filter and diluted with distilled water to 100 ml. This was analyzed by inductively-coupled plasma emission Spectrometry (ICP) or direct current plasma emission spectrometry (DCP). Mercury was determined by cold-vapor atomic absorption spectrometry (CVAAS).

Plant Tissue Digestion and Heavy Metals Analysis. Heavy metals concentrations in ground plant tissues were determined on digest of *Spartina alterniflora* grown in test sediments and WRS1. Digests of NBS 1572 (citrus leaves) were also analyzed. The digest procedure was similar to the procedure for sediment except for sample mass and microwave settings. Ten ml of nitric acid was added to 0.5 g of plant tissue and allowed to pre-digest for 30 minutes. Digest vessels were sealed and microwave power was applied at 480 W for 1 min 30 sec and 300 W for 10 min. After cooling, the procedure continued as in the sediment procedure.

Sediment and Plant Tissue Heavy Metal Concentration. Sediment and plant tissue metal concentrations were calculated by the following equation:

$$\text{metal concentration} = \frac{\text{digest solution metal concentration x dilution volume}}{\text{grams of ODW sediment or tissue actually digested}}$$

$$= \frac{\text{ug/ml x 100 ml}}{\text{g sediment or tissue digested}}$$

$$= \frac{\text{ug metal}}{\text{g of sediment or tissue}}$$

Blanks and NBS standards were also included in the analysis. Blank concentrations were subtracted from the solution concentrations prior to using the above equation. Final concentration values were not corrected for percent recovery of NBS standards.

Butyltin and PAH Sample Preparation and Analysis. Sediment samples for determination of butyltin and PAH concentrations were stored at 4° C in glass amber bottles with teflon closures. Plant tissue samples were frozen. Sediment and plant tissue samples were shipped by Federal Express 24-hr delivery in heavy-duty ice chests with freeze packs to Battelle Marine Sciences Laboratory in Sequim, WA for analysis.

Results and Discussion

Soil/Sediment Characteristics. Soluble salts (determined by electrical conductivity) were 27.2 mmhos/cm in the West Richmond reach sediment and 19.25 and 17.69 mmhos/cm in the PSC2 and PSC3, respectively (Table III-1). The pH values of 7.89, 7.42 and 7.33 for WRC1, PSC2 and PSC3, respectively, are typical and pose no problem. Organic matter content was higher in the PSC2 and PSC3 (5.32 and 5.19 percent) than in WRC1 (4.16 percent).

Soluble salts in the WRC1 could be somewhat of a limiting factor for plant establishment. Soluble salts concentrations in the PSC2 and PSC3 were considered moderate and were not expected to be a limiting factor for establishment of *Spartina alterniflora.*

Heavy Metal Concentrations in J. F. Baldwin Sediments and WRS1. Comparisons of heavy metal concentrations in J. F. Baldwin sediments were presented and discussed in Section II. However, that data is again presented in Table III-2 to include the heavy metals data for WRS1. Note that only 1/3 of total chromium in NBS reference material was recovered. The microwave procedure used apparently resulted in an incomplete digestion of the sediment. This suggests that chromium concentrations in PSC2, PSC3 and WRS1 are as much as

three times higher than reported. Likewise, nickel concentrations in PSC2, PSC3 and WRS1 would be corrected to 117, 95 and 12 mg/kg, respectively. Correction to account for percent recovery of the NBS standard reference material will be necessary to more accurately compare data analyzed by different methods and/or laboratories.

Polycyclic Aromatic Hydrocarbon Concentrations in J. F. Baldwin Sediments and WRS1. Mean PAH concentrations in J. F. Baldwin sediments were reported and discussed in section II of this report. However, the data are again presented here along with PAH concentrations found in the WRS1. As shown in Table III-3, PAH concentrations were lower in WRS1 than Baldwin sediments except for naphthalene, phenanthrene and fluoranthene in PSC2 and PSC3, and pyrene in PSC2.

Butyltin Concentrations in J. F. Baldwin Sediments and WRS1. Mean sediment butyltin concentrations were also reported and discussed in section II of this report, but are again presented to include the WRS1 butyltin data. Mean concentrations of butyltin in WRS1 were below method detection limits as shown in Table III-4.

Growth of Spartina alterniflora. The mean yields of Spartina alterniflora grown in test sediments and WRS1 are shown in Table III-5. Although only two replicates survived in the PSC2, mean yield was higher than that in the PSC3. Yields were extremely reduced in the WRC1 with a mean yield of 1.60 g dry weight from three of four surviving replicates. Mean yield was less in the WRS1 treatments flooded with 15 ppt salt water than in those flooded with fresh water (RO water). Price (unpublished data, 1991)[1] demonstrated reductions in Spartina alterniflora growth as salinity of irrigation water increased from 0 to 15 to 30 parts per thousand. Reduced growth in the J. F. Baldwin sediments, however, are suspected to be a result of other factors in combination with salt concentrations.

The lowest yields in WRS1 occurred in the air dry treatments. The appearance of Spartina alterniflora in the Baldwin sediments and WRS1 are shown in Figure III-4. Spartina alterniflora in the three WRS1 treatments are shown in Figure III-5.

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[1] Richard A. Price, USAE Waterways Experiment Station, Vicksburg, MS

Plant Uptake of Heavy Metals. Heavy metal concentrations and total metal uptake by plants are shown in Table III-6. Heavy metal concentrations in Spartina alterniflora grown in Baldwin sediments differed very little from those grown in WRS1. Cadmium, lead, and nickel plant tissue concentrations were, in fact, higher in WRS1 than in Baldwin sediments. Lee et al. (1976) reviewed existing wetland literature and showed tissue concentration ranges for Spartina alterniflora of zinc and copper of 11-17 and 2-4 ug/g, respectively. In addition, Simmers et al, (1981) found that field collected, natural Spartina alterniflora contained tissue concentrations of zinc, nickel and copper of 15, 6.0 and 1.2-5.5 ug/g, respectively. Test results for plants grown on Baldwin sediments are similar or lower than these values. Huiskes et al. (1986) and Davies et al. (1983) grew Spartina alterniflora in more highly contaminated sediments and found tissue zinc concentrations (Table III-7 and III-8) higher than that found in plants grown on either of the Baldwin sediments, but in the range of naturally occurring saltmarsh areas sampled by Simmers et al. (1981). Even sediment containing 1,307 ug/g zinc produced Spartina alterniflora with tissue contents of 12.1-21.1 ug/g zinc in the CE/EPA FVP site (Table III-9). These concentrations of zinc are equal to that found in natural saltmarshes. Davies et al. (1983) also found no measurable difference in tissue contents of metals in Spartina alterniflora and Spartina angelica. These data suggest that Spartina alterniflora may be a good indicator of metal uptake by other species of Spartina. The field survey data in Table III-10 shows Spartina foliosa contained zinc concentrations ranging from 21 to 98 ug/g, nickel concentrations ranging from 1.96 to 9.29 ug/g and copper concentrations ranging from 4.35 to 13.9 ug/g.

Plant tissue concentrations of metals in Baldwin sediments did not exceed concentrations found in 1990 field survey Spartina foliosa (Table III-10 for As, Cd, Cr, Cu, Pb, Ni, and Zn). Cadmium concentrations in Spartina alterniflora grown in the Baldwin sediments were low and below the range of 0.02 ug/g for natural occurring salt marshes sampled by Simmers et al. (1981) for Spartina alterniflora, as well as the field survey data in Table III-10 of

this report for Spartina foliosa, (0.032-0.22 ug Cd/g). Even with a sediment cadmium content as high as 22.3 ug/g, Spartina alterniflora only took up small amounts of cadmium under wetland conditions (Table III-9). These data suggest that plant uptake of cadmium under wetland environmental conditions should not be of concern.

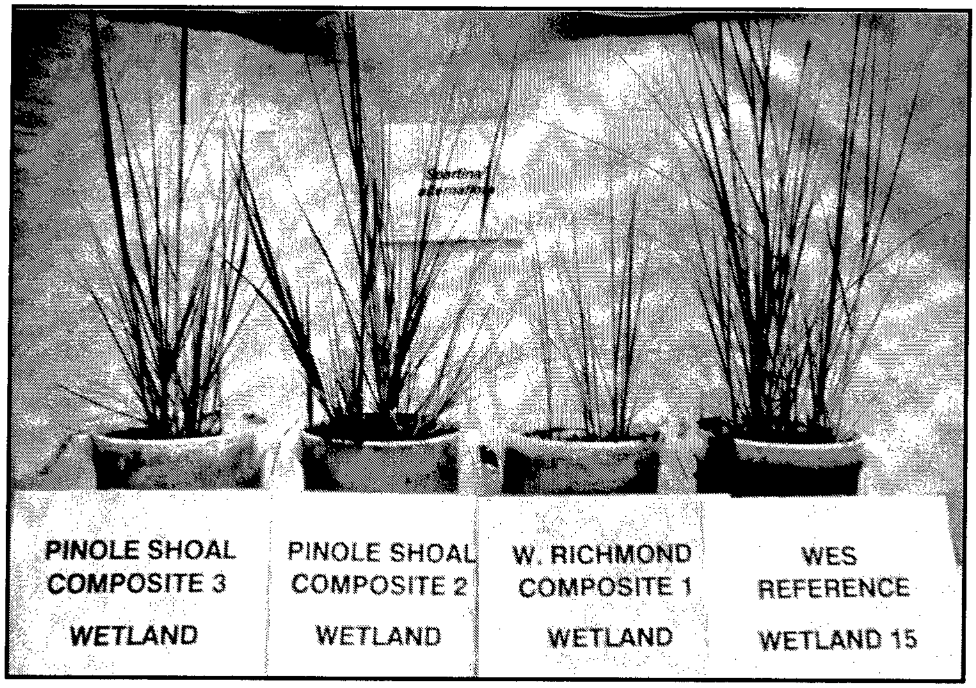

Figure III-4. Appearance of Spartina alterniflora Growing in the Various Test Substrates

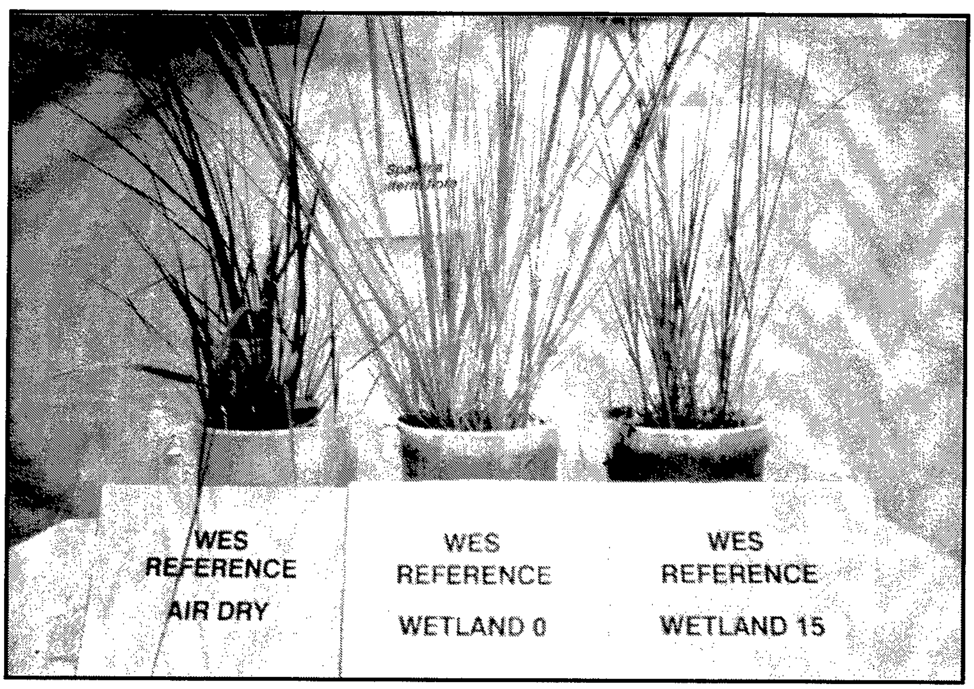

Figure III-5. Appearance of Spartina alterniflora Growing in the WES Reference Soil at Different Salinities

Lead concentrations in Spartina alterniflora were approximately 3 ug/g, which appear to be higher than observed (1.3 ug/g) by Simmers et al. (1981) in natural wetlands. However, the field survey in Table III-10 of this report showed that Spartina foliosa in natural saltmarshes in the San Francisco Bay area have tissue lead concentrations ranging from 0.60-4.9 ug/g. These lead contents are similar to those observed at the FVP site (397.8 ug/g). Davies et al. (1983) found Spartina alterniflora tissue lead contents as high as 12.6 ug/g in sediments impacted by lead mining with concentrations of 1,136 ug/g lead.

Another way to consider plant tissue metal contents is in relationship to existing consumable foodstuff guidelines. Lead concentrations in plants grown in Baldwin sediments as well as WRS1 exceed the European action level of 0.1 mg/kg on a fresh weight basis[2] for root vegetables and cereal, but are below the action level of 1.2 mg/kg fresh weight for leafy vegetables (WHO 1972). The lead plant tissue concentrations from the Baldwin sediments and WRS1 are one half or more the Dutch action level of 5.0 mg/kg dry weight for mixed animal feed (van Driel et al. 1985).

These data suggest that plant tissue lead contents in existing wetlands may be of concern to the foodwebs associated with these sites in the San Francisco Bay Area. Wetlands created with Baldwin sediments have the potential to produce wetland plants with lead concentrations equal to that existing in present wetland sites.

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[2] 0.1 mg/kg tissue lead on a fresh weight basis approximately corresponds to 1.0 mg/kg tissue lead on an oven dry weight basis.

Table III-1

EC, pH, % Moisture, and OM for PSC2, PSC3, WRC1 and WRS1

Parameter	PSC2	PSC3	WRC1	WRS1
pH	7.42	7.33	7.89	6.50
EC mmhos/cm	19.25	17.69	27.20	1.75
% Moisture	65.57	57.15	42.32	53.34
Organic Matter	5.32	5.19	4.16	4.25

Table III-2

Heavy Metals in PSC2, PSC3, WRC1 and WRS1

Metal	PSC2 WT	PSC3 WT	WRC1 WT*	WRS1 AD**	%Recovery NBS 1646
As, mg/kg[1]	7.408[2] (0.235)[3]	10.058 (0.054)	9.60 (1.21)	3.59 (0.06)	63.0
Cd, mg/kg	0.113 (0.076)	<0.035 (0.035)	0.27 (0.02)	0.24 (0.02)	98.0
Cr, mg/kg	36.318 (2.841)	30.660 (1.141)	206.0 (26.9)	4.64 (0.16)	32.1
Cu, mg/kg	32.755 (0.630)	33.332 (0.260)	28.4 (3.07)	4.64 (0.33)	76.2
Pb, mg/kg	22.512 (1.172)	25.039 (0.734)	14.48 (0.57)	10.66 (1.07)	132.9
Ni, mg/kg	60.406 (1.957)	48.605 (1.168)	78.4 (2.79)	6.30 (0.60)	51.3
Se, mg/kg	<0.330 (0.000)	<0.310 (0.000)	0.144 (.006)	<0.215 (0.01)	93.5
Ag, mg/kg	<0.166 (0.000)	<0.283 (0.128)	0.118 (.039)	<0.262 (0.16)	NA
Zn, mg/kg	60.450 (4.729)	61.123 (2.361)	78.6 (3.36)	16.44 (1.67)	70.2
Hg, mg/kg	0.121 (0.013)	0.381 (0.027)	0.164 (.024)	0.103 (0.00)	107.0#

1 Dry weight basis.

2 Mean of replicates.

3 Standard deviation.

* Wet condition, data from Table II-1.

** Only air-dried WRS1 was analyzed.

Reported by Analytical Laboratory Group

Table III-3

Mean Sediment PAH Concentrations (ug/kg dry weight)

	SEDIMENT			
Parameter	WRS1	WRC1*	PSC2*	PSC3*
Naphthalene	11.9 (2.8)[1]	< 32.6	6.0 (0.4)	6.3 (0.5)
Acenaphthylene	< 3.8 (0.1)	13.98	< 5.5 (0.2)	< 5.6 (0.1)
Acenaphthene	< 3.8 (0.1)	14.10	< 5.5 (0.2)	< 5.6 (0.1)
Fluorene	4.7 (0.5)	15.76	< 5.5 (0.2)	< 5.6 (0.1)
Phenanthrene	27.5 (14.8)	289.60	7.4 (0.5)	8.8 (1.2)
Anthracene	< 3.8 (0.1)	57.40	< 5.5 (0.2)	< 5.6 (0.1)
Fluoranthene	22.9 (12.8)	407.80	9.0 (1.2)	20.4 (3.5)
Pyrene	16.1 (8.4)	513.80	11.6 (2.0)	26.5 (4.9)
Benzo(a)anthracene	5.3 (1.3)	259.80	< 5.5 (0.2)	10.1 (1.9)
Chrysene	< 4.6 (0.8)	170.30	< 5.5 (0.2)	10.5 (2.0)
Benzofluoranthenes **	< 7.8 (0.1)	582.40	< 12.2 (1.1)	27.9 (5.7)
Benzo(a)pyrene	< 3.8 (0.1)	466.20	7.7 (1.6)	18.2 (3.5)
Indeno(1,2,3-c,d)pyrene	< 3.8 (0.1)	316.60	7.1 (1.2)	12.6 (3.1)
Dibenzo(a,h)anthracene	< 3.8 (0.1)	48.92	< 5.5 (0.2)	< 5.6 (0.1)
Benzo(g,h,i)perylene	< 3.8 (0.1)	496.60	8.3 (1.6)	15.8 (3.8)

* PAH concentrations for WRC1, PSC2 and PSC3 from Table II-4.
** all benzofluoranthene isomers (b,j and k) were quantified together

Table III-4

Sediment Butyltin Concentrations, ug/kg dry weight

Butyltin	WRS1	WRC1	PSC2	PSC3
Tetra	< 0.36 (0.02)*	< 0.9	< 0.63 (0.02)	< 0.55 (0.03)
Tri	< 0.46 (0.09)	1.14 (0.15)	1.32 (0.52)	0.97 (0.11)
Di	< 0.36 (0.02)	0.70 (0.07)	0.97 (0.26)	< 0.55 (0.03)
Mono	< 0.72 (0.33)	< 0.8	< 0.63 (0.06)	< 0.50 (0.00)
TOTAL	1.90	3.54	3.55	2.57

* values shown in parentheses are standard deviations

Table III-5

Fresh and Dry Weight Yields (g) of _Spartina alterniflora_

Sediment	Fresh Weight	Dry Weight
WRS1 (15ppt)	44.41 (3.48)[4]*	23.99 (2.26)[4]
WRS1 (0ppt)	103.36 (13.56)[4]	44.53 (5.26)[4]
WRS1 (Air Dry)	40.45 (1.49)[4]	13.49 (2.08)[4]
PSC2	31.67 (4.59)[2]	17.95 (3.84)[2]
PSC3	21.7 (4.44)[4]	11.50 (2.48)[4]
WRC1	4.25 (0.99)[3]	1.60 (0.37)[3]

* Mean (Standard deviation) number of surviving replicates.

Table III-6.

Concentration (mg/kg dry weight) and Total Plant Metal Uptake (ug dry weight) in _Spartina alterniflora_

	Sediment/Soil							
	WRS1		**PSC2**		**PSC3**		**WRC1**	
Parameter	Content	Uptake	Content	Uptake	Content	Uptake	Content	Uptake
As	<0.997 (0.001)[1]	<23.93 (2.28)	<0.998 (0.004)	<17.90 (3.77)	<0.992 (0.001)	<13.51 (2.04)	<1.188 (*)	<1.90 (0.44)
Cd	0.035 (0.021)	0.824 (0.48)	0.010 (0.010)	0.22 (0.22)	0.000 (0.000)	0.00 (0.00)	0.000	0.00 (0.00)
Cr	<0.997 (0.001)	<23.93 (2.28)	<0.998 (0.004)	<17.90 (3.77)	<0.992 (0.001)	<13.51 (2.04)	<1.188	<1.90 (0.44)
Cu	3.290 (0.238)	78.76 (8.80)	4.389 (0.381)	80.27 (23.7)	3.406 (0.360)	45.05 (5.97)	3.325	5.31 (1.24)
Pb	4.087 (0.034)	98.09 (11.1)	2.605 (2.605)	36.75 (36.8)	0.858 (0.565)	15.37 (10.1)	3.325	5.31 (1.24)
Ni	1.346 (0.094)	31.69 (1.17)	0.000 (0.000)	0.000 (0.00)	0.198 (0.072)	3.16 (1.35)	0.000	0.00 (0.00)
Se	<6.262# (0.000)	<131.2 (131)	0.998 (0.004)	17.90 (3.77)	<1.025 (0.033)	<13.71 (1.90)	<1.188	<1.90 (0.44)
Ag	0.000 (0.000)	0.00 (0.00)	<0.200 (0.001)	<3.58 (0.76)	<0.198 (0.000)	<2.70 (2.70)	<0.238	<0.38 (0.09)
Zn	11.066 (1.265)	265.7 (41.5)	14.470 (0.560)	257.6 (45.7)	13.088 (1.243)	168.5 (18.2)	9.739	15.54 (3.63)
Hg	<0.032 (0.000)	<0.072 (0.072)	0.048 (0.000)	0.90 (0.24)	<0.029 (0.000)	<0.34 (0.07)	<0.032	<0.51 (0.12)

[1] (Standard deviation)

* Only one composite sample was available for analysis due to low yields.

\# 1 of 4 replicates was significantly above detection limits.

Table III-7

Concentrations of Metals in Spartina alterniflora Grown in Contaminated Dutch Sediments (Huiskes et al. 1986)

Metal	Field Test Plant Yield g/pot	Field Test Tissue Content ug/g	Field Test Sediment Content ug/g	Greenhouse Test Plant Yield* g/pot	Greenhouse Test Tissue Content ug/g	Greenhouse Test Sediment Content ug/g
Zinc		21±6	505	39-140	23.2	453
Cadmium		0.23±.12	13.5		0.214	12.0
Copper		4.4±.8	93		3.44	84.0
Lead		1.1±.3	153		0.388	123
Arsenic		0.41±.10	--		0.152	--

* grams of fresh weight

Table III-8.

Concentrations of Metals in Spartina alterniflora Grown in Contaminated Welsh Sediments (Davies et al. 1983)

Metal	Field Test Plant Yield* g/pot	Field Test Tissue Content ug/g	Field Test Sediment Content ug/g	Greenhouse Test Plant Yield* g/pot	Greenhouse Test Tissue Content ug/g	Greenhouse Test Sediment Content ug/g
Zinc	10.6-33.3	30.8-52.2	26.5-448	27.3-58	15.0-32.9	26.5-448
Cadmium		0.045-0.32	0.05-0.70		0.023-0.065	0.05-0.70
Copper		3.34-6.41	5.96-306		1.03-3.03	5.96-306
Lead		7.02-12.6	38.2-1136		2.36-9.78	38.2-1136
Chromium			6.22-20.5			6.22-20.5
Nickel			17.1-57.3			17.1-57.3
WES	16.5			101.5		

* grams of fresh weight

Table III-9.

Concentrations of Metals in *Spartina alterniflora* Grown in Highly Contaminated Black Rock Harbor Sediments at the FVP Site (Brandon et al. 1991)

Metal	Field Test			Greenhouse Test		
	Plant Yield* g/m^2	Tissue Content ug/g	Sediment Content ug/g	Plant Yield* g/pot	Tissue Content ug/g	Sediment Content ug/g
Zinc	226-798	13.5-21.1	1,307		12.1	1,307
Cadmium		<0.003-0.23	22.4		0.041	22.4
Copper		5.65-16.5	2,728		4.02	2,728
Lead		0.95-3.8	397.8		0.237	397.8
Chromium		5.7-10.4	1,651		0.274	1,651
Nickel		0.74-4.23	178.8		0.954	178.8

* grams of fresh weight

Table III-10 Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in mg/kg, dry-weight basis)

		Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
		Mean	Range	Mean	Range	Mean	Range
Metals							
As:	***Spartina***	1.14*	<0.86 - 1.82	NA	NA	NA	NA
	Salicornia	0.91*	<0.003 - 2.20	<0.94$	<0.92 - <0.95	NA	NA
	Scirpus	NA	NA	<1.46$	<0.71 - <4.2	0.85*	0.79 - <0.87
	Typha	NA	NA	<0.81$	<0.77 - <0.87	<0.88$	<0.83 - <0.91
Cr:	***Spartina***	6.65*	2.5 - 8.9	NA	NA	NA	NA
	Salicornia	4.99*	0.4 - 25.4	2.65	1.7 - 3.6	NA	NA
	Scirpus	NA	NA	4.34*	3.3 - 6.4	2.33	0.7 - 4.0
	Typha	NA	NA	<3.65$	<3.4 - <4.1	5.83*	<4.0 - 8.0
Cu:	***Spartina***	8.05	4.35 - 13.9	NA	NA	NA	NA
	Salicornia	10.7	6.52 - 19.1	10.75	10.1 - 11.4	NA	NA
	Scirpus	NA	NA	7.36	5.52 - 10.13	19.4	13.6 - 31.1
	Typha	NA	NA	6.14	4.06 - 10.18	6.53	4.0 - 9.41
Ni:	***Spartina***	5.20	1.96 - 9.29	NA	NA	NA	NA
	Salicornia	4.45*	<0.93 - 19.20	2.82	1.85 - 3.78	NA	NA
	Scirpus	NA	NA	3.93	1.97 - 4.26	6.59	4.47 - 9.39
	Typha	NA	NA	2.41	2.16 - 2.64	5.35	4.27 - 9.40
Pb:	***Spartina***	2.81*	0.60 - 4.90	NA	NA	NA	NA
	Salicornia	2.07*	0.23 - 5.40	0.85	0.71 - 0.99	NA	NA
	Scirpus	NA	NA	2.04*	1.18 - 2.50	0.79	0.49 - 1.03
	Typha	NA	NA	2.05*	<1.9 - 2.19	2.8*	<2.1 - 4.0
Se:	***Spartina***	0.73*	<0.63 - 0.85	NA	NA	NA	NA
	Salicornia	<0.82$	<0.63 - <2.20$	<0.70 -	<0.71	NA	NA
	Scirpus	NA	NA	<0.61$	<0.58 - <0.65	<0.61$	<0.56 - <0.65
	Typha	NA	NA	<0.65$	<0.63 - <0.69	<0.63$	<0.62 - <0.66
Zn:	***Spartina***	45.7	21.2 - 98.0	NA	NA	NA	NA
	Salicornia	30.6	12.04 - 57.4	30.3	29.8 - 30.8	NA	NA
	Scirpus	NA	NA	40.1	27.2 - 48.4	92.7	59.3 - 133.0
	Typha	NA	NA	19.2	17.8 - 19.0	71.9	34.3 - 98.8
Cd:	***Spartina***	0.076	0.032 - 0.22	NA	NA	NA	NA
	Salicornia	0.109	0.05 - 0.29	0.12	0.07 - 0.17	NA	NA
	Scirpus	NA	NA	0.24	0.08 - 0.37	0.18	0.13 - 0.24
	Typha	NA	NA	0.064	0.035 - 0.100	0.11	0.07 - 0.14
Hg:	***Spartina***	0.016	0.008 - 0.027	NA	NA	NA	NA
	Salicornia	0.022	0.01 - 0.038	0.027	0.019 - 0.034	NA	NA
	Scirpus	NA	NA	0.024	0.012 - 0.038	0.035	0.018 - 0.050
	Typha	NA	NA	0.019	0.012 - 0.026	0.014	0.010 - 0.010

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA: Not applicable. No plants of this species at this site.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Butyltins						
Tetrabutyltin:						
Spartina	3.24[*]	<2.1 - 2.7	NA	NA	NA	NA
Salicornia	6.65[*]	<1.6 - 54.7	2.75[*]	<3.1 - 2.4	NA	NA
Scirpus	NA	NA	3.88[*]	1.2 - 6.1	3.93[*]	1.2 - 5.5
Typha	NA	NA	8.7[^]	2.2 - 11.4	12.33[*^]	<3.2 - 18.3
Tributyltin:						
Spartina	4.82[*]	<2.5 - 9.2	NA	NA	NA	NA
Salicornia	7.51[*^]	<1.8 - 35.8	4.6	4.4 - 4.8	NA	NA
Scirpus	NA	NA	8.02[^]	2.2 - 14.7	4.97	2.2 - 5.6
Typha	NA	NA	4.13[^]	2.2 - 5.7	5.78[*^]	<3.6 - 8.4
Dibutyltin:						
Spartina	3.07[*]	<2.1 - 3.7	NA	NA	NA	NA
Salicornia	5.18[*]	<1.4 - 13.2	2.6[*]	<3.0 - 2.2	NA	NA
Scirpus	NA	NA	3.78[*]	<2.9 - 6.7	3.43[*]	1.1 - 5.6
Typha	NA	NA	3.0[^]	2.5 - 3.7	3.45[*^]	2.3 - 4.4
Monobutyltin:						
Spartina	4.78[*]	<1.9 - 19.8	NA	NA	NA	NA
Salicornia	15.6[*]	<1.3 - 64.3	20.35	5.6 - 35.1	NA	NA
Scirpus	NA	NA	4.2[*]	<2.9 - 5.0	5.87[*^]	<3.7 - 9.5
Typha	NA	NA	7.45[*^]	<2.2 - 14.0	4.7[*^]	<3.0 - 7.0
PCBs						
Aroclor 1016						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1221						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1232						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]

[*] : This mean contains at least one less than value.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
[^] : Indicates analyte detected in the blank.
NA: Not applicable. No plants of this species at these sites.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PCBs						
Aroclor 1242						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1248						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1254						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1260						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
PAHs						
Acenaphthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Acenaph-thylene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Anthracene						
Spartina	11.3[*]	<10 - 26	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]

[*] : This mean contains at least one less than value.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
NA: Not applicable. No plants of this species at these sites.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PAHs						
Benzo [a] Anthracene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Benzo [b] Fluoranthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Benzo [b] Fluoranthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Benzo [k] Fluoranthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Benzo [a] Pyrene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Benzo [g,h,i] perylene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Chrysene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]

[*] : This mean contains at least one less than value.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
NA: Not applicable/Not available. No plants of this species at these sites.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Dibenzo [a,h] anthracene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Fluoranthene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	10.06*	<10 - 11	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Fluorene						
Spartina	10.42*	<10 - 15	NA	NA	NA	NA
Salicornia	10.06*	<10 - 11	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Indeno-1,2,3-pyrene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
2-Methyl-Naphthalene						
Spartina	24.83*	<20 - 32	NA	NA	NA	NA
Salicornia	24.31*	<20 - 37	NA	NA	NA	NA
Scirpus	NA	NA	NA	NA	NA	NA
Typha	NA	NA	NA	NA	NA	NA
Naphthalene						
Spartina	56.17*	28 - 88	NA	NA	NA	NA
Salicornia	57.31*	16 - 98	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Phenanthrene						
Spartina	20.5*	<10 - 31	NA	NA	NA	NA
Salicornia	13.69*	<10 - 37	<10$	<10@	NA	NA
Scirpus	NA	NA	14.8*	<10 - 18	15	10 - 18
Typha	NA	NA	12.75*	<10 - 20	12.5*	<10 - 18
Pyrene						
Spartina	10.17*	<10 - 12	NA	NA	NA	NA
Salicornia	10.13*	<10 - 12	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits. NA: Not applicable.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
Pesticides	Mean	Range	Mean	Range	Mean	Range
Aldrin:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
a-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	11.02[*]	<2.0[#] - 2.3	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
b-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
d-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
g-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Chlordane:						
Spartina	<20.7[$]	<2.0 - <30	NA	NA	NA	NA
Salicornia	<16[$]	<2.0 - <30	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
4,4-DDD:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
4,4-DDE:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]

[*] : This mean contains at least one less than value.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
[#] : There was a less than value much higher than this highest actual number.
NA: Not applicable/Not available. No plants of this species in these sites.

Table III-10 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
4,4-DDT:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Dieldrin:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Endosulfan I:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	11.02[*]	<2.0[#] - 2.3	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Endosulfan II:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Endosulfan sulfate:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Endrin:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Endrin Aldehyde:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]

[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
NA: Not applicable/Not available. No plants of this species at these sites.

Table III-10 Concluded. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
Heptachlor:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Heptachlor Epoxide:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Methoxychlor:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Toxaphene:						
Spartina	$<123.5^{\$}$	<2.0 - <200	NA	NA	NA	NA
Salicornia	$<80.75^{\$}$	<2.0 - <200	NA	NA	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$

* : This mean contains at least one less than value.
$^{@}$: Every variable in this set was this same value.
$^{\$}$: All values were less than detection limits.
$^{\#}$: In this range there was a less than value much higher than this highest actual value.
NA: Not applicable/Not available. No plants of this species at these sites.

Plant Uptake of Polycyclic Aromatic Hydrocarbons. Little evidence exits that plants readily take up PAH compounds by translocation from the roots to the plant stem and leaf tissues. Folsom (1982) and Folsom and Preston (1983) indicated that S. alterniflora did not take up PAH or PCB compounds. However, more recent data (possibly due to increased detection ability) indicates that some PAH compounds and their metabolites are translocated from the roots to other plant parts. Edwards (1986) demonstrated that bush bean plants took up translocated anthracene and its metabolites from the plant root to the stems and leaves. Edwards also indicated that the most likely pathways of PAHs contamination of food is by direct deposition from the atmosphere onto vegetation and deposition on soil with subsequent uptake by plants through the roots. Volatilization from sediment and atmospheric deposition onto plants may provide a mechanism for availability into the foodweb of higher animals. Since no data were available on plant uptake of PAHs in wetlands in the San Francisco Bay area, the potential for PAH contamination of plants on Baldwin sediments was of concern and, therefore, was evaluated.

Mean PAH concentrations in Spartina alterniflora grown in WRS1 and Baldwin sediments are presented in Table III-10. Only naphthalene exceeded 10 ug/kg wet weight for any of the sediments. S. alterniflora grown in WRC1 sediment contained 27 ug/kg wet weight of naphthalene. Although sediment PAH concentrations were substantially higher in WRC1 than in PSC2 and PSC3, PAHs were no more mobile to S. alterniflora grown in WRC1 than in PSC2 and PSC3.

To assess the environmental implications of the PAH uptake by S. alterniflora, a comparison can be made to the PAH uptake by naturally occurring wetland plants, from Table III-10. PAH concentrations in S. alterniflora grown in Baldwin sediments are shown to be in the range of concentrations found in Spartina foliosa growing in naturally occurring wetlands in Table IV-11. None of the PAH analytes detected in S. alterniflora grown in Baldwin sediments exceeded the range of concentrations found in S. foliosa growing in naturally occurring wetlands. This indicates that if Baldwin sediments are placed in a wetland condition, plant concentrations of

PAHs will be in the range of plant concentrations in current naturally occurring wetlands.

The field survey data includes Spartina foliosa and the plant bioassay data is of Spartina alterniflora. However, differences in uptake of contaminants between the two plants have been considered. Although PAH uptake has not been compared between the two species of Spartina, a hydroponic study (Lee, Sturgis and Landin, 1980) found that S. alterniflora had somewhat more potential to take up zinc, cadmium and nickel than S. foliosa. This suggests that S. alterniflora is a good indicator of heavy metal uptake for S. foliosa.

Mean total uptake of PAHs in Spartina alterniflora is presented in Table IV-11. Total uptake of PAH is a result of concentration in ug/kg wet weight x the total fresh weight yield/pot. As a result of higher yields, total plant uptake is greater in the WRS1 and PSC2 grown Spartina alterniflora. Total uptake of the lower molecular weight PAH analytes was greater in the WRS1, except for naphthalene, and was greater for the higher molecular weight analytes in the PSC2.

Movement of PAHs into plants and availability to the food chain should not be of concern in the J. F. Baldwin sediments.

Table III-11.

PAH Concentrations in Spartina alterniflora
(ug/kg wet weight)

Parameter	WRS1	PSC2	PSC3	WRC1
	Sediment/Soil			
Naphthalene	<2.97 (0.46)	6.33 (1.09)	8.91 (2.18)	27.18
acenaphthy-lene	1.61 (0.46)	<4.08 (0.05)	<5.98 (1.44)	<9.16
Acenaphthene	<1.32 (0.08)	<2.20 (0.02)	<3.23 (0.78)	<4.95
Fluorene	1.05 (0.15)	1.30J (0.29)	1.85J (0.37)	2.74J
Phenanthrene	6.19 (0.53)	<2.00 (0.00)	2.85 (0.50)	3.81
Anthracene	0.74 (0.08)	<1.81 (0.02)	<2.65 (0.64)	<4.06
Fluoranthene	2.95 (0.29)	2.16 (0.12)	2.31J (0.42)	4.64
Pyrene	2.86 (0.34)	2.12 (0.10)	2.15J (0.44)	3.19J
Benzo[a]anthracene	0.39 (0.05)	2.29J (0.76)	<4.42 (1.07)	<6.77
Chrysene	0.52 (0.08)	1.80J (0.34)	<3.10 (0.75)	<4.75
Benzo[b]fluor-anthene	<1.56 (0.43)	4.77 (1.65)	<4.51 (1.09)	<6.91
Benzo[k]fluor-anthene	<1.59 (0.08)	2.80 (0.19)	<3.78 (0.91)	<5.79
Benzo[a]pyrene	<1.65 (0.09)	<2.68 (0.04)	<3.93 (0.95)	<6.03
Indeno[1,2,3-cd]-pyrene	<1.96 (0.09)	4.04 (0.78)	<4.72 (1.14)	<7.23
Dibenzo[a,h]an-thracene	<1.35 (0.07)	<2.19 (0.03)	<3.21 (0.77)	<4.92
Benzo[g,h]pery-lene	<2.69 (0.14)	4.37 (0.05)	<6.40 (1.54)	<9.80

Table III-12.

Comparison of Plant PAH Concentrations in Baldwin Sediments to Field Survey Data.

Parameter	Sediment/Soil PSC2	PSC3	WRC1	Range in Field Survey*
Naphthalene	6.33	8.91	27.18	<10 - 88
acenaphthylene	<4.08	<5.98	<9.16	<10
Acenaphthene	<2.20	<3.23	<4.95	<10
Fluorene	1.30J	1.85J	2.74J	<10 - 15
Phenanthrene	<2.00	2.85	3.81	<10 - 18
Anthracene	<1.81	<2.65	<4.06	<10 - 26
Fluoranthene	2.16	2.31J	4.64	<10
Pyrene	2.12	2.15J	3.19J	<10 - 19
Benzo[a]anthracene	2.29J	<4.42	<6.77	<10
Chrysene	1.80J	<3.10	<4.75	<10
Benzo[b]fluoranthene	4.77	<4.51	<6.91	<10
Benzo[k]fluoranthene	2.80	<3.78	<5.79	<10
Benzo[a]pyrene	<2.68	<3.93	<6.03	<10
Indeno[1,2,3-c,d]-pyrene	4.04	<4.72	<7.23	<10
Dibenzo[a,h]anthracene	<2.19	<3.21	<4.92	<10
Benzo[g,h]perylene	4.37	<6.40	<9.80	<10

* Appendix B.

Table III-13.

Total Plant Uptake of PAH (ug/pot)

	Sediment/Soil			
Parameter	**WRS1**	**PSC2**	**PSC3**	**WRC1**
Naphthalene	<119	201	193	116
acenaphthylene	65	<129	<130	<39
Fluorene	42	41J	40J	21J
Phenanthrene	250	<63	62	16
Anthracene	30	<57	<58	<17
Fluoranthene	119	68	50J	20
Pyrene	116	67	47J	14J
Benzo[a]anthracene	16	73J	<96	<29
Chrysene	21	57J	<67	<20
Benzo[b]fluoranthene	<63	151	<98	<29
Benzo[k]fluoranthene	<64	89	<82	<25
Benzo[a]pyrene				
Indeno[123-cd]-pyrene	<79	128	<102	<31
Dibenzo[a,h]-anthracene				
Benzo[g,h]perylene	<109	139	<139	<42

Plant Uptake of Butyltins. Butyltins data are reported on a wet weight basis, due to the small amount of plant tissue available. Detection limits are also reduced compared to the field survey data (Appendix B).

Butyltin concentrations in Spartina alterniflora were below the detection limits of 38.3, 18.1 and 16.4 ug/kg wet weight for tributyltin, dibutyltin and monobutyltin, respectively (Table III-13). However, one replicate in WRS1 and one in PSC3 had detectable butyltin concentrations, although the values were below MDL. Tributyltin was detected in WRS1 grown Spartina alterniflora at 21 ug/kg wet weight. This is equivalent to 33.3 ug/kg on a dry weight basis. Dibutyltin was detected below MDL at 33.5 ug/kg wet weight in PSC3 grown Spartina alterniflora, which would be 72.35 ug/kg on a dry weight basis. Tributyltin was detected in only 1 of 5 replicates of WRS1 soil. Dibutyltin was reported below detection limits in PSC3 sediment. Therefore, the validity of the detected concentrations is questionable.

Tributyltin concentrations were as high as 9.2 ug/kg dry weight in Spartina foliosa and 35.8 ug/kg in Salicornia subterminalis (Table III-10). Concentrations up to 3.7 and 19.8 ug/kg dry weight, dibutyl and monobutyltin, respectively, also occurred in S. foliosa. Francois and Weber (1988) found up to 190 and 130 ug/kg dry weight dibutyl and monobutyltin, respectively, in Zosteria marina L. (eelgrass) growing in the Great Bay Estuary, NH. Tributyltin was not detected below approximately 100 ug/kg dry weight. They considered the Great Bay Estuary to be relatively free of butyltin pollution.

Since butyltin data from the plant bioassay is below detection limits in contrast with data from the field survey, a comparison between plant tissue concentrations in Baldwin sediments and naturally occurring wetlands is difficult. Very little data were available on the uptake of butyltin by plants as most of the concern is directed toward toxicity in other marine organisms. Francois and Weber (1988) suggested that measurable levels of dibutyl and monobutyltin in seagrasses might be a method of detecting low-level tributyltin contamination in aquatic environments. Seagrasses may be able to reduce toxic tributyltin species to less toxic dibutyl and monobutyltins. If

this is the case, then uptake in plants might be considered a benefit rather than a problem.

Since the butyltin concentrations in S. alterniflora grown in Baldwin sediments were below concentrations in eelgrass (Francois and Weber 1988) grown in wetlands considered minimally polluted, plant uptake of butyltin in Baldwin sediments are not of environmental concern.

Table III-14.

Mean Butyltin Concentrations in
Spartina alterniflora (ug/kg wet weight)

	Sediment/Soil			
Parameter	WRS1	PSC2	PSC3	WRC1
Tributyltin	<33.97J[1] (4.33)*	<38.30 (0.00)	<38.30 (0.00)	<38.30
Dibutyltin	<18.10 (0.00)	<18.10 (0.00)	<21.95J[1] (0.00)	<18.10
Monobutyltin	<16.40 (0.00)	<16.40 (0.00)	<16.40 (0.00)	<16.40

1 1 of 4 replicates detected at 21.0 ug/kg (value below MDL).

2 1 of 4 replicates detected at 33.5 ug/kg (value below MDL).

* Standard deviation.

Plant Impacts and Controls

Leaf tissue concentrations of heavy metals were equal to or below those concentrations found in naturally occurring wetlands in the San Francisco Bay area. Both laboratory test data and field survey data suggest a potential for migration of plant tissue lead into foodwebs associated with the wetland sites. Concentrations of PAHs did not exceed levels found in naturally occurring wetlands and should not require controls. Butyltin concentrations were determined to be below concentrations in eelgrass growing in a minimally polluted estuary and should not be of concern. Restrictions are generally not required for wetland plants established on Baldwin Harbor sediments. The status of lead in naturally occurring wetland foodwebs in the San Francisco Bay area should be monitored and further evaluated.

IV. WETLAND ANIMAL TEST

Approach

Contaminant pathways from dredged material into wetland animal foodwebs consist of migration of contaminants into three types of animals: sediment dwellers, surface dwellers, and filter feeders. Consequently, the wetland animal bioassay tests included these types of animals for a comprehensive evaluation. An annelid, Nephtys, was used to represent a sediment dweller. The mud dogwhelk (snail), Nassarius = Ilyanassa, was used to represent a surface dweller. A ribbed mussel, Modiolus = Geukensia, was used to represent a filter feeder. These species indicate migration of contaminants from sediment directly into animals that burrow and feed in the sediment, animals that live and feed on the surface of the sediment, and animals that filter the tidal water that enters and leaves the created wetland.

Selection of these animals was based on their living habits and their size. Sufficient size, or amount of tissue, for chemical analysis was a major consideration in the selection. Nephtys is a smaller annelid than the sandworm, Nereis, which was used successfully in previous testing under the Corps/EPA Field Verification Program (Simmers et al. 1989). However, the sandworm does not live and feed exclusively within the sediment, but also feeds on the sediment surface. The intent in the present study was to use an animal that lives and feeds exclusively within the sediment to separate the "within sediment" pathways from the "surface feeding" pathways.

Methods and Materials

Each mixed sediment was placed in a standard 15-gal low aquarium (12x24x12") with a simulated daily tide (Figure IV-1) of either brackish water (12 ppt) for the estuarine wetland mesocosm or saltwater (24 ppt) for the marine wetland mesocosm. West Richmond sediment (WRD) was air dried and periodically agitated to accelerate the drying. After the sediment had dried, it was exposed to the same tidal regime as the other mesocosms. Instant Ocean dissolved in aged tap water was used as the source of brackish water and

saltwater. The experimental design is presented in Table IV-1. Each wetland was replicated three times. The total number of experimental units was 5 sediments X 2 wetland types X 3 replicates = 30 (Figures IV-2, IV-3). The aquaria were placed in a water bath with a water temperature ranging of 8-21 degrees C from Oct 90 to Apr 91 and 18-25 degrees C from May 91 to Aug 91. Supplemental lighting was used to maintain a 16 hr daylight period from Oct 90 to Apr 91. The tidal cycle was changed to an in-tide that was left in the mesocosm for two days followed by out-tide for one day and then repeat in-tide. This change was implemented to control water temperatures. Due to increased greenhouse temperatures in May through August, the Instant Ocean water stock supply tanks warmed to above 25 degrees C prior to entry into the mesocosms. This resulted in a fluctuation of water temperatures in the mesocosms. Aeration stones were placed in each mesocosm in June to maintain a dissolved oxygen concentration ranging from 5 to 15 ppm.

After the tidal regime was established and the tidal system tested and regulated, the plants were added to the system. Wetland plants were supplied by Dr. Michael Josselyn, Wetland Research Associates, Inc., from local areas in the San Francisco Bay and Suisun Bay. Harvested plants were wrapped and shipped over night delivery to the WES. These plants were kept moist in the greenhouse until five plants of each species were transplanted into both the high and low marsh simulation areas of each mesocosm. In the brackish water aquaria, Scirpus olynei was planted in the low or less-drained portion of each mesocosm and Salicornia subterminalis was planted in the high marsh or least inundated portion of each mesocosm. For the saltwater or marine portion of the test, Spartina foliosa was planted in the low marsh and Salicornia subterminalis was planted in the high marsh. These planting strategies were consistent with the estuarine and marine ecosystems observed in the San Francisco Bay-Suisun Bay region during the field survey.

Plants were allowed to grow for six months (Oct 90 - Apr 91). Additional plants were used to replace any plants that died. After six months of plant growth, animals were added to the mesocosms.

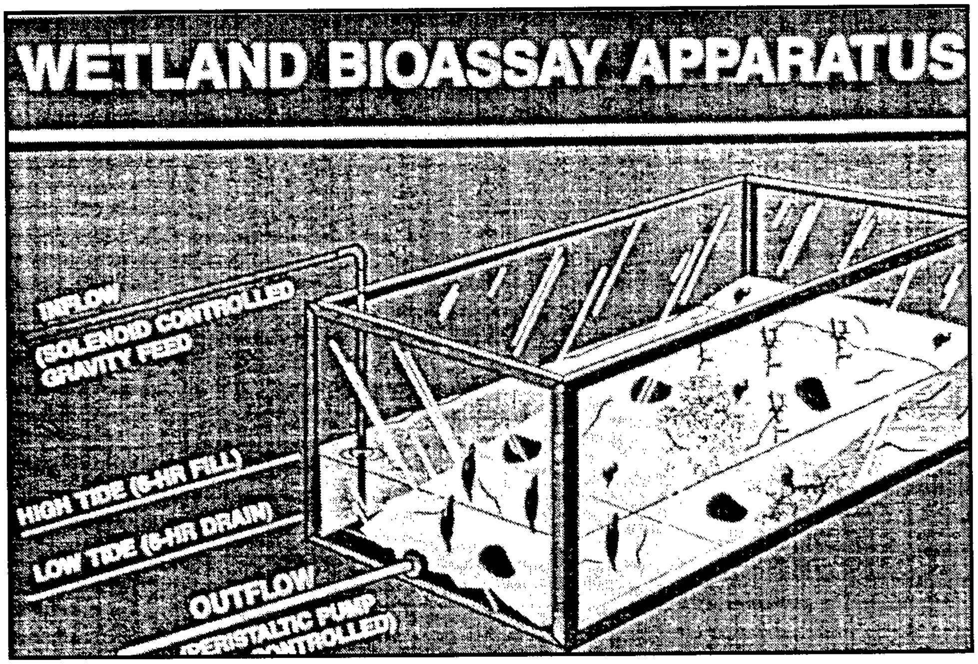

Figure IV-1. Wetland Bioassay Apparatus

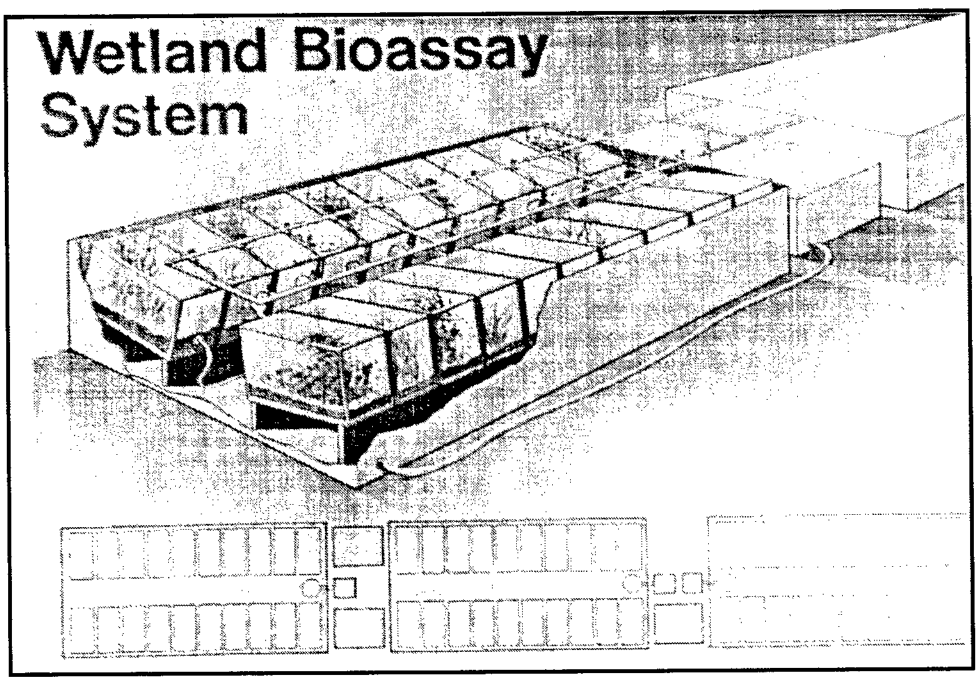

Figure IV-2. Wetland Bioassay System

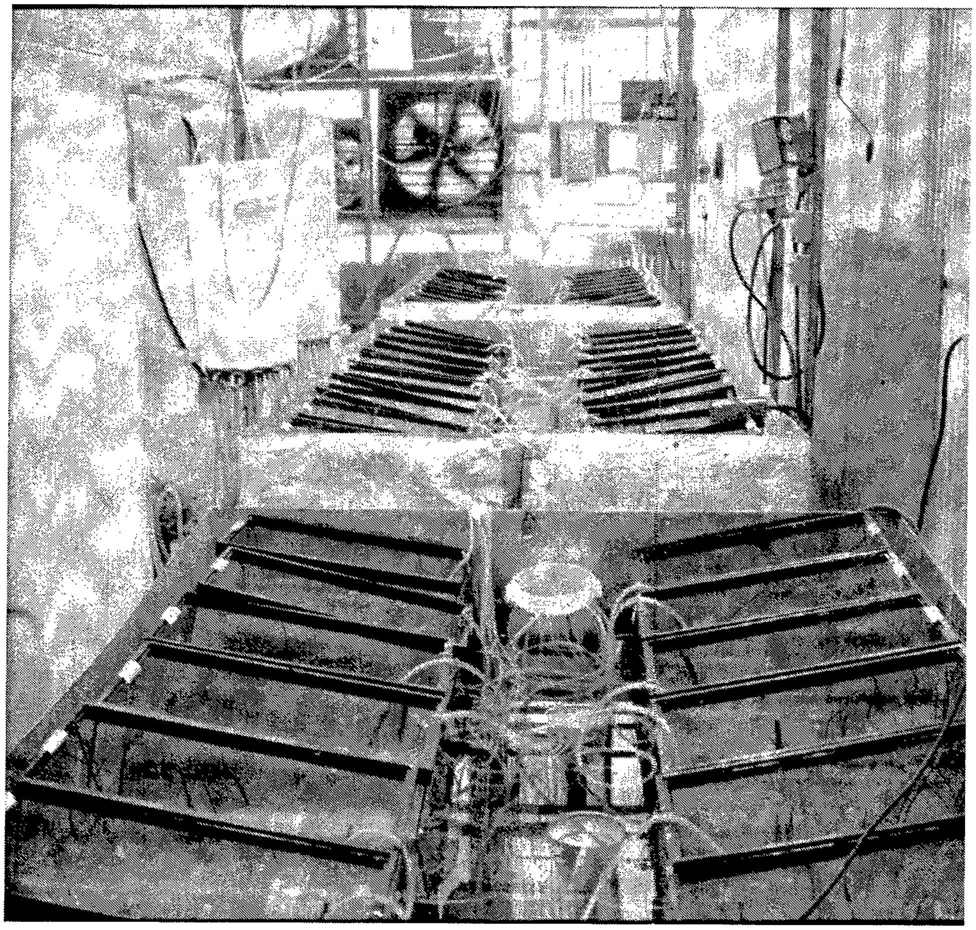

Figure IV-3. Greenhouse Wetland Bioassay System

Mud dogwhelks (Nassarius=Ilyanassa) were obtained from San Francisco Bay wetlands by Wetland Research Associates, Inc. Nephtys were collected from the Pacific Coast by John Brezina and Associates. After in spite of numerous attempts by both Wetland Research Associates, Inc and John Brezina and Associates, sufficient live mussel beds were not found in the San Francisco area. Consequently, another mussel, Modiolus=Geukensia (ribbed mussels), was collected by a WES field crew in West Haven, Connecticut (Figure IV-4). These mussels were living in a salinity of 24 ppt in-tide water, 15 ppt out-tide water at an air temperature of 80-85 degrees F at the time of collection.

Animals were exposed for 30 days. An approximate fresh weight of 10-15 grams of each animal species were counted out and placed into each aquarium (Figures IV-5, IV-6, IV-7, IV-8, IV-9). This weight of animals resulted in 35 Nassarius, 15 Modiolus, and 21 Nephtys in each of the aquaria. At the end of 30 days exposure, animals were harvested, counted, rinsed in RO water and placed into Ziploc bags for freezing (Figure IV-10). Tissues of surviving animals were analyzed for metals (Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn), TBT, PAHs, and PCBs.

Figure IV-4. Mussel Collection Site in West Haven, CT

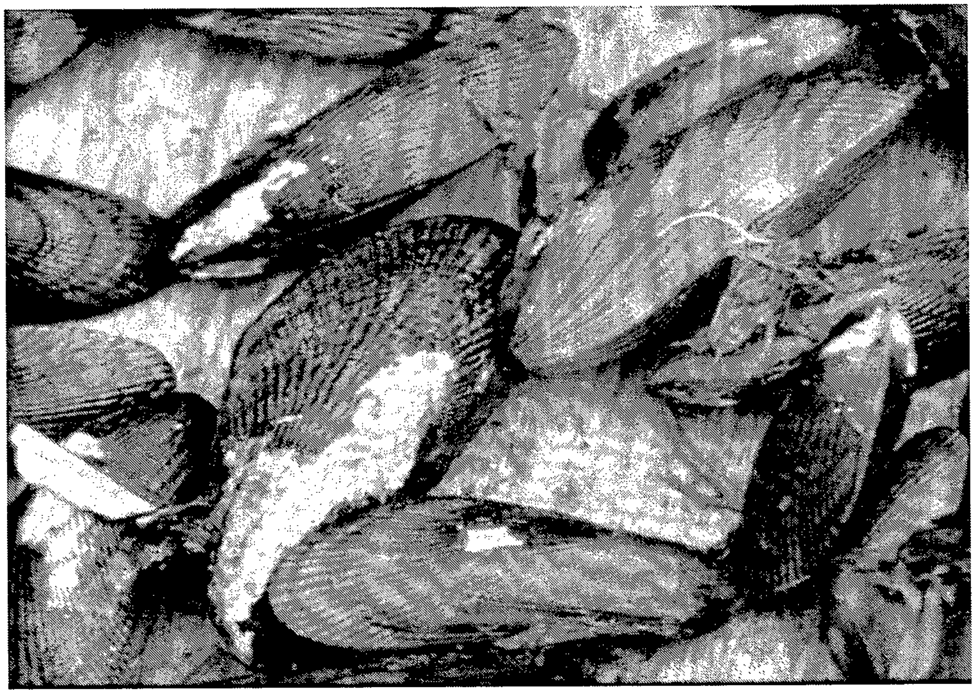

Figure IV-5. Ribbed Mussel Used in the Wetland Bioassay

Figure IV-6. Ribbed Mussel Were Placed in the Wetland Bioassay

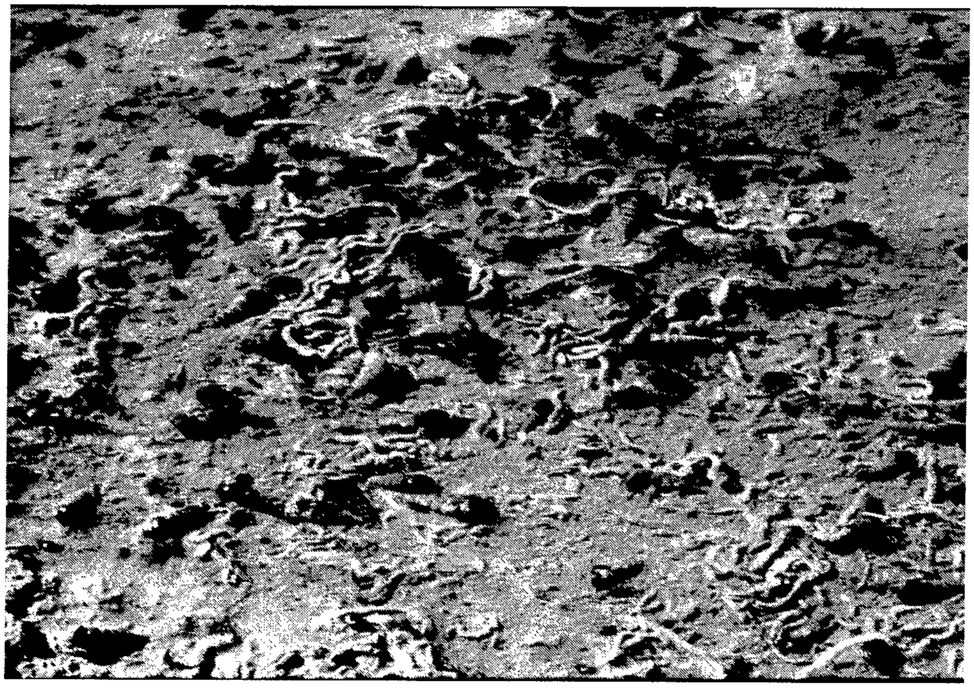

Figure IV-7. Mud Dogwhelk Snails Used in the Wetland Bioassay

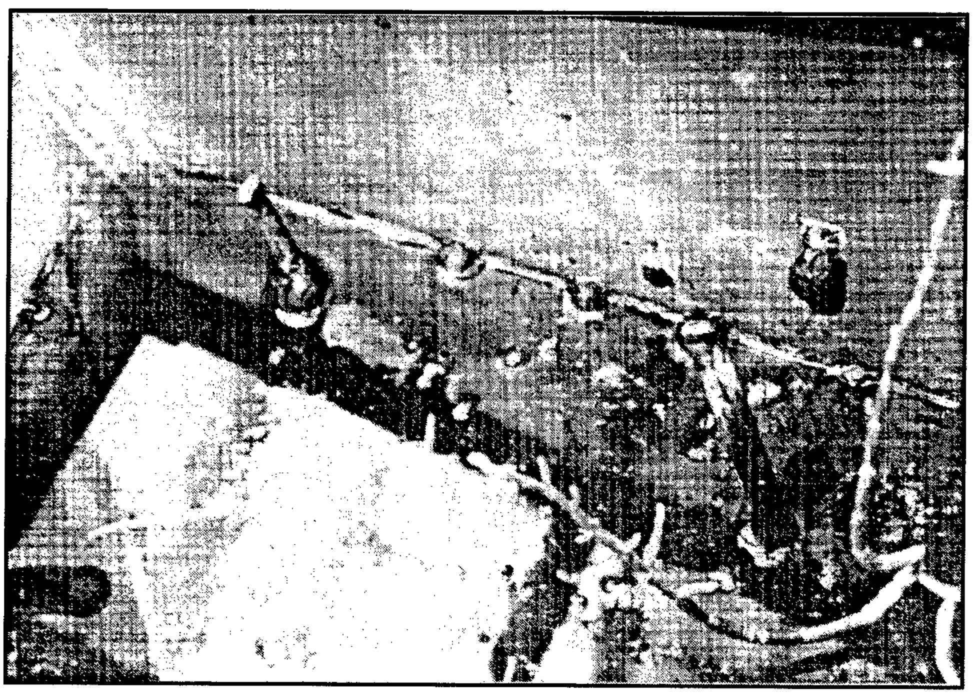

Figure IV-8. Mud Dogwhelk Snail on Edge of Mesocosm at or Above Tidewater

Figure IV-9. Annelid, Nephtys, on Surface of Sediment at Top of Figure

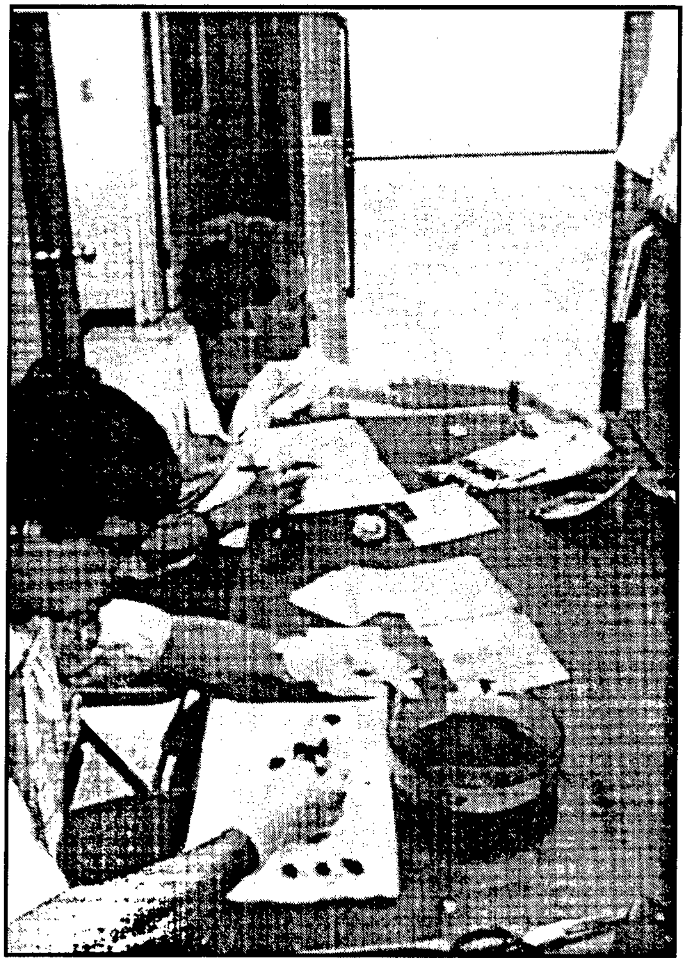

Figure IV-10. Mud Dogwhelk Snail Harvesting, Rinsing, and Bagging

Results and Discussion

Plant Growth and Appearance. Plant growth of *Spartina foliosa* in the saltwater wetland aquaria and *Scirpus olynei* in the brackish water wetland aquaria was very poor. Transplanting shock set back *Spartina foliosa*. However, the high sediment salinity (35 ppt) along with transplant shock effects were toxic to *Scirpus olynei*. Both species were harvested toward the end of their growing season (October 1991) and may have been sensitive to harvesting and transplanting processes that shocked the plants into a dormant stage. *Salicornia subterminalis*, on the other hand, grew exceptionally well in both brackish water and saltwater wetland aquaria. Even though brackish water was applied in a tide, the salinity of the water leaving in the out-tide was approximately 20 ppt for the six months period of plant growth. The plants are shown in Figures IV-11 through IV-15. Plant growth after three months was slow in the marine reference sediment (Figure IV-11), Pinole Shoal (C3) sediment (Figure IV-12), West Richmond sediment (Figure IV-13), and Pinole Shoal (C2) sediment (Figure IV-14). When Baldwin sediments were placed in a brackish estuarine tidal mesocosm, an extraordinary algal mat developed (Figure IV-14 for PSC2). *Scirpus olynei* showed poor growth or died in the brackish estuarine mesocosms. After three months and no signs of regrowth, new *Scirpus olynei* transplants were collected and a second planting was attempted. Some transplants grew, but poorly. The estuarine reference sediment from Suisun Slough, Site No. 14, showed good growth in two of three replicates. The third replicate had a heavy growth of native marshgrass that was not one of the selected test species, but competed successfully to eliminate *Scirpus* from the mesocosm. The marsh grass can be seen in replicate 1 of the estuarine reference in Figure IV-15. Fresh weights of plant tissue harvested for chemical analysis are shown in Tables IV-2 and IV-3. *Salicornia* produced the most biomass of all the species evaluated. Plant growth was good in a second marine reference that used the FVP Black Rock Harbor contaminated sediment as substrate (Table IV-2). *Salicornia* grew well in the marine sand substrate, while *Spartina foliosa* did poorly.

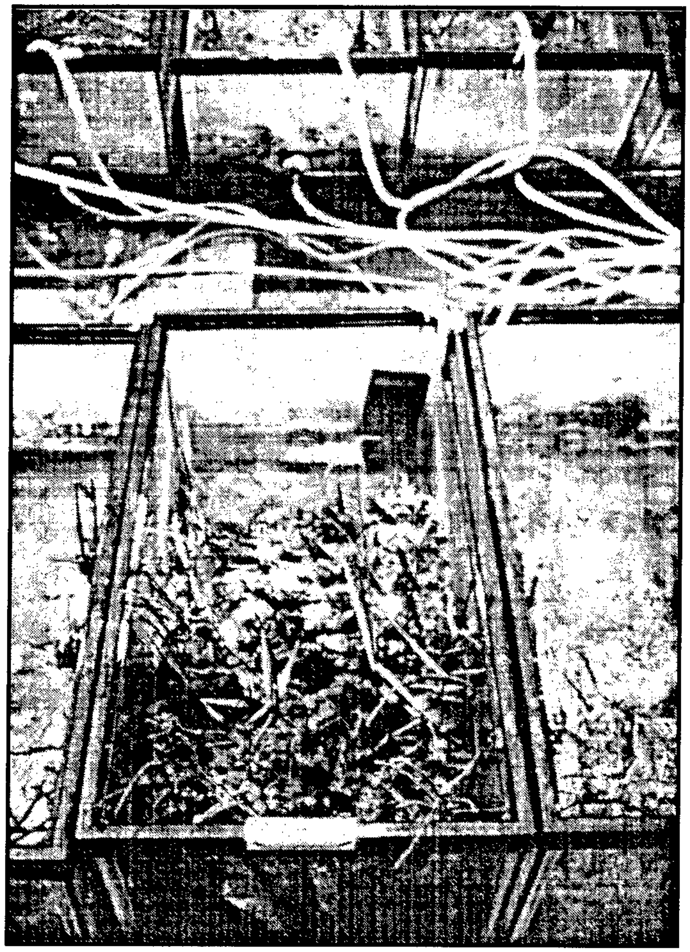

Figure IV-11. Marine Reference (Site 1) Wetland Bioassay Mesocosm

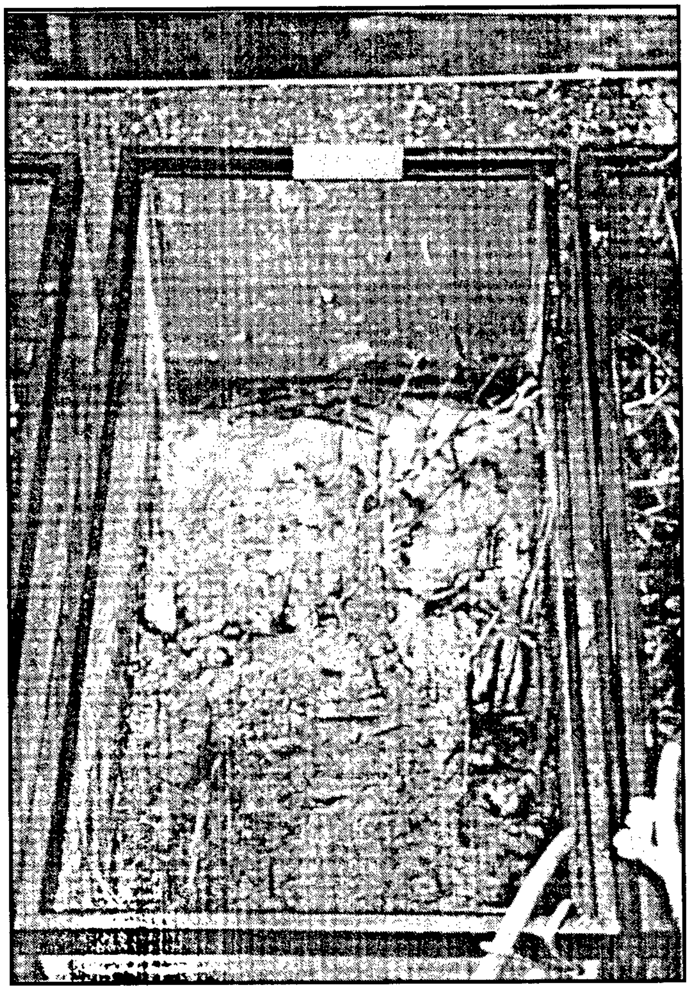

Figure IV-12. Pinole Shoal (PSC3) Sediment Marine Wetland Bioassay Mesocosm

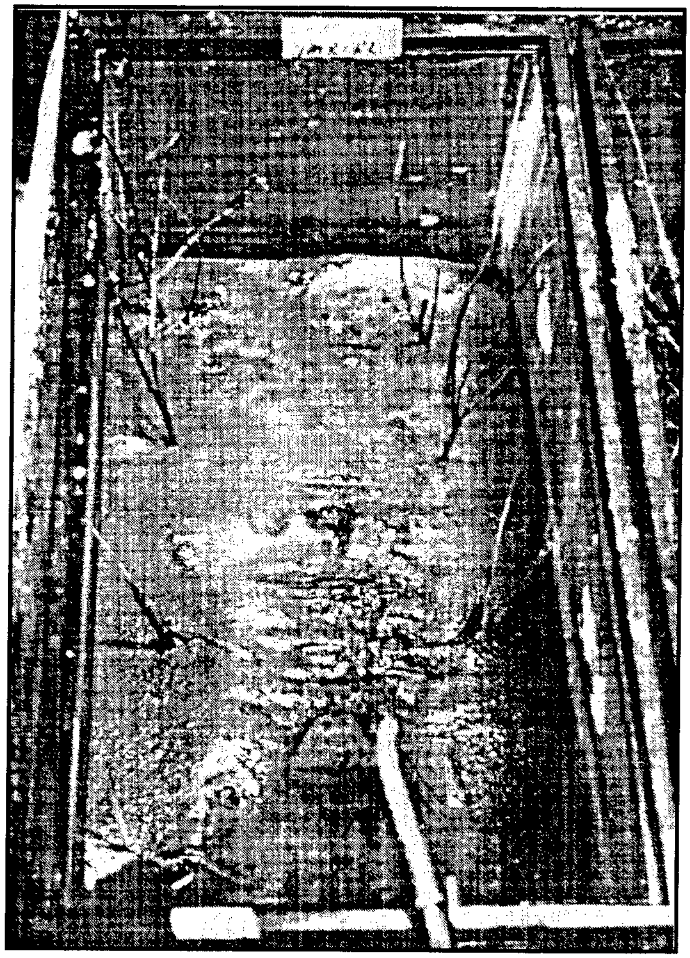

Figure IV-13. West Richmond (WRC1)
Sediment Marine Wetland Bioassay Mesocosm

Figure IV-14. Pinole Shoal (PSC2) Sediment Estuarine Wetland Bioassay Mesocosm

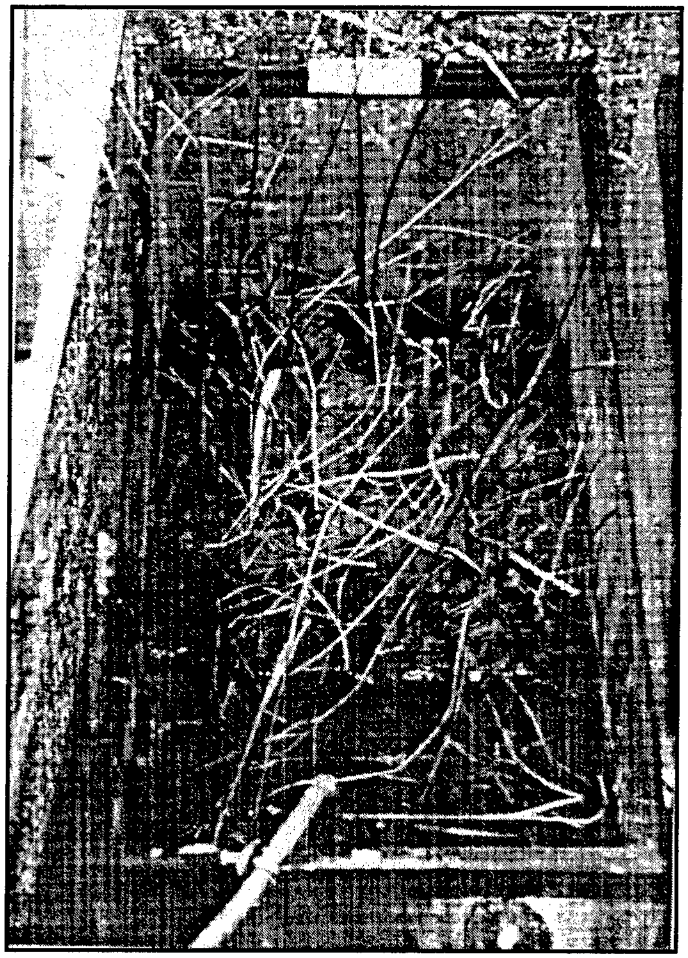

Figure IV-15. Estuarine Reference
(Site 14) Wetland Bioassay Mesocosm

Chemical Analyses of Plant Tissue. Whenever plant yields did not give sufficient weight for chemical analyses, one or more replicates were composited to obtain enough tissue to analyze for all contaminants of concern. Plant tissue heavy metal concentrations are shown in Table IV-4 and IV-5, for the marine and estuarine mesocosms. Spartina foliosa contained similar concentrations of all metals, except for zinc, when grown in the test sediments than that observed in plants grown in the marine reference and the sand reference substrates. Tissue metal contents were generally lower than those of the marine reference samples.

Heavy metals concentrations in Salicornia subterminalis were lower than in plants grown in the marine reference and were within the range of concentrations observed in plants assayed in the field survey of existing wetlands in the San Francisco Bay area. Placing the test sediments in an estuarine (brackish water) environment resulted in tissue metal concentrations in Salicornia subterminalis similar to those in plants grown in the estuarine reference and within the range of values observed in plants from the field survey (Appendix B).

Creating wetlands with J.F. Baldwin Project sediments will produce plants with tissue metal concentrations in the range of existing wetlands in the San Francisco Bay area. Availability of sediment metals for plant uptake under wetland environments are limited as shown in the plants grown on the highly contaminated FVP dredged material used as a reference in this evaluation.

PAH concentrations in mesocosm plants shown in Tables IV-6 through IV-8 were usually near the detection limits. Only phenanthrene was present above detection limits in the Spartina grown on the PSC2 sediment as well and on the marine reference (MR) sediment (Table IV-6). Salicornia grown on the WRC1AD Composite and WRD Rep 2 sediments in marine mesocosms contained slightly elevated levels of fluoranthene (Table IV-7). PAH concentrations in plants grown on PSC2, PSC3, and WRC1 substrates were below detection limits with the exception of low levels of phenanthrene, pyrene, and fluoranthene (Table IV-

8). Spartina grown in FVP dredged material contaminated with 5,000 and 6,300 ug of phenanthrene and fluoranthene per kg, respectively. Brandon et al. (1991) showed tissue concentrations of only 2.13-6.72 ug phenanthrene per kg and 2.02-12.86 ug fluoranthene per kg. Therefore, it is not surprising to see near detection limit concentrations of PAHs in plants grown in Baldwin Project sediments. In summary, PAH concentrations in the Salicornia either in marine or estuarine mesocosms were negligible with only Fluoranthene, Phenanthrene, and Pyrene being above detection limits for the Pinole Shoal and West Richmond sediments, but similar to that observed for the estuarine reference and the sand control reference.

Pesticide concentrations were in the parts per billion range, with the most notable accumulations above detection limits in the Salicornia grown in the PSC2 and PSC3 mesocosms (Tables IV-9 through IV-11). Tissue concentrations of Lindane, Aldrin, a-Endosulfan,and Endosulfan Sulfate were slightly elevated in the Spartina grown in the PSC2 sediment when compared to that observed in the marine reference (Table IV-9). Under both marine and estuarine conditions Salicornia accumulated pesticides to only low levels, near the detection limits (Tables IV-10 and IV-11). These data do not indicate a potential for pesticides to accumulate in wetland plants to concentrations that approach or exceed FDA levels considered for animal feed.

PCBs and Butyltin were not detected in the plants from either the marine or estuarine mesocosms (Tables IV-12 and IV-13).

Animal Survival. The survival rates of wetland animals are presented in Tables IV-14 and IV-15. Snails and mussels showed good survival. The annelid, Nephtys, showed poor survival in both attempts to expose them to the sediments. Heavy algal growth on the surface of each sediment appeared to seal off the sediment surface. Penetration of the algae mat had to be done mechanically with a finger or some other firm object. Nephtys that did not find a hole in the algae mat soon became weak and died on the surface of the sediment. The first attempt to place Nephtys in the mesocosm with snails

resulted in the snails attacking the annelids before they could burrow into the sediment. The presence of an algae mat limited and delayed Nephtys from burrowing into the sediment, resulting in more destruction by snails. The second attempt to place Nephtys in the mesocosm was after the snails were harvested. Again Nephtys could not penetrate the algae mat without help. After 30 days, no annelids were found alive in any of the mesocosms, even the sand controls. The fresh weight of animals harvested after 30 days exposure in the marine sediment wetland mesocosms are presented in Table IV-14. Snails and mussels survived in most mesocosms with the except of snails in the marine reference sediment, Site 1. There were no snails observed at this site during the field survey collection of plants, animals and sediments. Survival of snails and mussels was good in the FVP contaminated marine sediment mesocosm. The survival of snails in the estuarine wetland mesocosms is shown in Table IV-15. Mussels were extremely hard to collect on the West Coast, however, sufficient mussels were collected on the East Coast for the marine mesocosms and consequently the estuarine mesocosms did not receive mussels.

Chemical Analyses of Wetland Animal Tissue. Replicate animal tissue was composited whenever the weight of tissue was not sufficient for the entire chemical analysis of metals, butyltins, PAHs, PCBs, and pesticides. Snails used for the wetland animal bioassay mesocosms were collected from the San Francisco Bay area in an attempt to use local species. However, the background tissue metal concentrations were especially elevated in chromium, arsenic, lead and zinc (Tables IV-16 and IV-17). Exposure of these snails to test substrates in the marine mesocosms resulted in depuration of chromium, lead and zinc from the animals so that all animals contained less of these metals at the end of the exposure time. Tissue arsenic showed an increase in snails exposed to the all the sediments and mercury was elevated slightly above the levels of the animals on the marine reference sediment. The background tissue content of arsenic is above an action level of 10 ug/g arsenic for mollusks and crustacea in Australia (Lee et al. 1991). These data

suggest the presence of an elevated ambient arsenic, as well as chromium and lead, concentration in the wetland environments in the San Francisco Bay area. Tissue nickel concentrations were only slightly higher in snails exposed to Baldwin sediments than that observed for the initial background snail concentrations or that observed in snails exposed to the marine reference sediment. Tissue copper concentrations of background snails were above 3,000 ug/g, however, this appears to be common in snails since their metabolism requires elevated copper concentrations. Snails exposed to the test sediments appeared to maintain higher tissue concentrations of copper than snails in the marine reference and sand reference. While tissue zinc concentrations in snails exposed to the test sediments appeared to be higher than those exposed to the marine reference sediment and the sand control reference, all tissue zinc concentrations were below the initial background concentrations observed in the snails used in the tests. Tissue cadmium concentrations did not appear to be increased in snails exposed to Baldwin Project sediments when compared to the initial background concentrations in the snails used in the test. However, these tissue concentrations were similar to those observed in the marine reference and therefore should not be of concern. Even thought the tissue mercury of snails exposed to the test sediments appeared to be higher than the initial background snail tissue concentrations and that observed for snails exposed to the marine reference, snails in the sand control reference showed elevated tissue mercury concentrations also snails never exceeded tissue mercury concentrations of approximately 1 ug/g, which is considerably below the FDA level of 5 ug/g for mollusks and crustacea (Lee et al. 1991).

Placing J.F. Baldwin Project sediments in an estuarine wetland mesocosm showed similar results to the marine mesocosm exposures. Snails depurated chromium, zinc, and lead after exposure to either the test sediments or the estuarine reference sediment. Tissue arsenic concentrations were at or above the initial background tissue concentration of 17 ug/g, which is above the Australian action level of 10 ug/g of arsenic for mollusks and crustacea. Tissue cadmium concentrations in snails exposed to the test sediments were not

elevated over that observed in the snails exposed to the estuarine reference sediment. However, the sand control exposed snails showed similar or higher tissue cadmium concentrations, suggesting that the snail tissue concentrations observed for these sediments is not of concern.

Heavy metal tissue concentrations for mussels exposed in the marine mesocosms are shown in Table IV-18. All metals appeared to be observed at tissue concentrations equal to or less than that observed in the initial background mussel tissues, with the exception of tissue concentrations of chromium, nickel, copper, zinc, and lead in mussels exposed to the contaminated FVP dredged material. Even though the initial background tissue concentration of arsenic was approximately at the Australian action level of 10 ug/g, all sediments tested maintained tissue arsenic concentrations at or above this action level, with the possible exception of the FVP dredged material. Mussels exposed to J.F. Baldwin sediments contained similar concentrations of arsenic as that observed in mussels exposed to the marine reference or the sand control reference.

The effects of butyltins in wetland ecosystems is not known and the reason for evaluating butyltins in wetland creation with Oakland Harbor sediments. In the mesocosm bioassay procedure, there was insufficient tissue to evaluate the potential uptake of butyltins for all but the mussels. The ribbed mussels did appear to accumulate both tributyl- and dibutyltin to levels above the references (Table IV-19). Although tributyltin was present in the bioassay animals field collected for the test (BK REP 1 and BK REP 2), levels in the mussels exposed to PSC2, PSC3, WRC1, and WRC1AD sediments were elevated in comparison to the marine reference (MR). These levels are slightly elevated when compared to the initial background concentrations in mussels collected from a relatively pristine area, however, they do not exceed the 34.9-38.3 ug/kg tissue concentrations observed in the mussels collected at the marine reference site in the field survey described in Table IV-20. These data indicate that the accumulation butyltins in wetland animals as shown with

mussels should not be of concern when wetlands are created with J.F. Baldwin Project sediments.

PCB concentrations in the mussel tissues from the marine mesocosms are listed in Table IV-21. Only Aroclor 1254 was detected in the chemical analysis of mussel tissues. All mussels apparently depurated the PCBs initially contained as background concentrations in the field collected mussels (BK), with the exception of mussels exposed to the FVP dredged material. FVP exposed mussels accumulated an order of magnitude more Aroclor 1254 than any of the other mussels. Mussels exposed to the test sediments showed PCB concentrations similar to that observed for the marine reference sediment or the sand control reference. In the field survey, the mussels collected in the field did not exhibit any PCB concentrations above the detection limits shown. These data indicate that PCB uptake by wetland animals may be similar to that existing in the San Francisco Bay area and therefore may not be of concern.

Sufficient biomass permitted the analysis of ribbed mussel tissues for PAHs (Table IV-22). Generally all PAHs were below detection limits in the mussel tissues with the exception of Acenaphthene, Acenaphthylene, Naphthalene, Phenanthrene and Pyrene. Acenaphthene and Acenaphthylene were present in the initial background tissue of the mussels at concentrations greater than observed in any of the test sediments. Naphthalene and Phenanthrene appeared to be present in mussel tissues from all the Baldwin substrates. sediments as well as the marine reference sediment and the sand reference. Initial background tissue concentrations of Naphthalene and Phenanthrene were above 200 ug/kg and indicate that mussels were probably depurating Naphthalene and Phenanthrene over the exposure period. A similar situation appears to have occurred with Pyrene, initial background tissue concentrations were 66-81 ug/kg. These data suggest that while mussels contained certain PAHs after exposure to Baldwin sediments, the concentrations were probably influenced by the relatively high initial tissue background concentration and should not be of concern. The only mussels that appear to

have accumulated other PAHs, such as Benzo(a)anthracene, Benzo(k)fluoranthene, Chrysene, and Fluoranthene were those exposed to the FVP dredged material (Table IV-22).

Mussel tissue pesticide concentrations were present at relatively low levels, near detection limits, for all test sediments, for the marine reference, for the sand control reference and in the initial background tissues of the field collected mussels used in the test (Table IV-23). These low levels of pesticides do not appear to represent any concern for foodweb contamination in wetlands created with J.F. Baldwin Project sediments.

Table IV-1

Experimental Design of Parameter for Wetland Animal Tests

Three composite sediments:
1. West Richmond reach, wet WRC1, air-dried WRC1AD, (Figure II-1)
2. Pinole Shoal (PSC2), (Figure II-2, PIC-PVIIIR)
3. Pinole Shoal (PSC3), (Figure II-2, PXIL-PXIVC)

Two Reference Sediments:
1. One brackish water (Suisun Slough, Site 14, Figure III-1)
2. One saltwater (Hamilton Air Force Base, Site 1, Figure III-2)

Two Control Sediments:
1. One brackish water (sand)
2. One saltwater (sand)

Two wetland types:
1. Brackish water
2. Saltwater

Species:

Wetland Type	Plant Species	Animal Species
Brackish Water	Scirpus olynei	Sediment feeder - Nephtys incisa Surface feeder - Nassarius= (Ilyanassa) Filter feeder - Modiolus=Geukensia dimissus
Saltwater	Spartina foliosa Salicornia subterminalis	Sediment Feeder - Nephtys incisa Surface Feeder - Nassarius Filter Feeder - Modiolus

Table IV-2 Fresh Weights of Plant Tissue Harvested for Chemical Analysis from Marine Mesocosms (weight in g)

Sediment/soil	Rep	Spartina Rep	Spartina Mean	Salicornia Rep	Salicornia Mean
PSC2	1	12.342		14.820	
	2	0	7.6 b+	8.510	7.8 a
	3	10.391		0	
PSC3	1	7.607		5.004	
	2	12.112	10.2 b	5.060	5.2 a
	3	10.719		5.444	
WRC1	1	6.424		36.111	
	2	8.899	5.1 b	11.658	18.9 a
	3	0		8.918	
WRC1AD	1	0		5.399	
	2	4.457	1.5 b	19.002	10.4 a
	3	0		6.907	
Sand	1	0		4.544	
	2	0	0 b	8.313	5.5 a
	3	0		3.713	
Site 1 Ref*	1	5.939		24.534	
	2	17.783	14.3 b	23.894	17.4 a
	3	19.207		3.847	
FVP Ref^	1	105.131		12.519	
	2	207.420	112.3 a	5.939	17.2 a
	3	24.404		33.219	

* Field Survey Site No. 1, Hamilton Air Force Base Wetland
^ Black Rock Harbor Contaminated Reference
\+ Means followed by different letters within a column are statistically different at P=0.05.

Table IV-3 Fresh Weights of Plant Tissue Harvested for Chemical Analysis from Estuarine Mesocosms (weight in g)

Sediment/soil	Rep	Species			
		Scirpus		Salicornia	
		Rep	Mean	Rep	Mean
PSC2	1	2.00		231.34	
	2	0.88	0.96 a+	82.03	107.07 a
	3	0		7.84	
PSC3	1	0		43.11	
	2	5.16	1.72 a	52.45	41.10 a
	3	0		27.73	
WRC1	1	0		28.99	
	2	3.05	1.02 a	30.15	19.99 a
	3	0		0.83	
Sand	1	0		20.39	
	2	2.63	0.88 a	14.74	15.02 a
	3	0		9.92	
Site 14 Ref*	1	1.08		75.32	
	2	0	1.38 a	36.77	44.64 a
	3	3.07		21.84	

* Field Survey Site No. 14, Suisun Slough Wetland
\+ Means followed by the same letter within a column are not statistically different at P=0.05.

Table IV-4. Metal Concentration in Marine Mesocosm Wetland Plants (Concentration in ug/kg Dry Weight)

Substrate	Cr	Ni	Cu	Zn	As	Se	Cd	Hg	Pb
Spartina									
PSC2	<6.1 a+	**1.48 b**	**7.72 b**	**32.8 b**	**0.98 a**	<0.61 a	**0.106 b**	**0.013 c**	**0.341 b**
PSC3	<4.9 a	**1.75 b**	**7.33 b**	**35.2 b**	<0.66 a	<0.54 a	**0.060 b**	**0.011 c**	**0.223 b**
FVP*	**7.2 a**	**2.33 ab**	**16.80 a**	**52.5 a**	<0.85 a	<0.71 a	**0.233 a**	**0.022 b**	**1.086 a**
MR	<4.9 a	<1.00 b	**5.10 b**	**23.7 b**	<0.55 a	<0.50 a	**0.105 b**	**0.018 bc**	**0.216 b**
Sand	<9.4 a	**3.38 a**	**14.80 a**	**27.3 b**	<0.93 a	<0.74 a	**0.198 a**	**0.064 a**	**0.667 ab**
Salicornia									
PSC2	<10.0 a	<1.90 c	**7.71 a**	**14.6 a**	<0.91 a	<0.73 a	**0.055 a**	**0.033 a**	**0.142 a**
PSC3	<10.0 a	**2.60 ab**	**11.20 a**	**19.5 ab**	<0.93 a	<0.77 a	**0.077 a**	**0.030 a**	**0.208 a**
WRC1	<10.2 a	**2.13 bc**	**9.42 a**	**15.5 b**	<0.72 a	<0.74 a	**0.042 a**	**0.035 a**	**0.221 a**
WRC1AD	<10.2 a	**2.10 bc**	**8.52 a**	**11.8 b**	<0.91 a	<0.76 a	**0.034 a**	**0.029 a**	**0.071 a**
FVP	**8.2 a**	<1.64 c	**15.87 a**	**19.5 ab**	<0.78 a	<0.65 a	**0.247 a**	**0.062 a**	**2.288 a**
MR	<8.5 a	**2.98 a**	**9.56 a**	**24.45 a**	<0.79 a	<0.65 a	**0.115 a**	**0.045 a**	**0.236 a**

* mostly existing Spartina alterniflora regrowth, very little Spartina foliosa from transplants.
\+ Means followed by different letters within a column are statistically different at P=0.05, unless otherwise noted.
a statistically significant at P = 0.07.

Table IV-5. Metal Concentration in Estuarine Mesocosm in the Wetland Plant *Salicornia subterminalis* (Concentration in ug/kg Dry Weight)

Sediment	Cr	Ni	Cu	Zn	As	Se	Cd	Hg	Pb
PSC2	<8.40 a+	<1.75 a	**9.13 a**	**19.15 a**	<0.785 a	<0.71 a	**0.071 a**	**0.028 b**	**0.178 a**
PSC3	**9.83 a**	**1.67 a**	**9.69 a**	**21.20 a**	**0.840 a**	<0.67 a	**0.057 a**	**0.026 b**	**0.326 a**
WRC1	<8.25 a	<1.60 a	**6.23 a**	**15.45 a**	<0.750 a	<0.69 a	**0.033 a**	**0.030 b**	**0.159 a**
ER	<6.47 a	**1.55 a**	**8.16 a**	**20.13 a**	<0.993 a	<0.92 a	**0.056 a**	**0.058 a**	**0.321 a**
Sand	<6.00 a	**1.31 a**	**8.29 a**	**18.83 a**	<1.267 a	<0.94 a	**0.076 a**	**0.057 a**	**0.351 a**

+ Means followed by similar letters are not statistically different at P=0.05.

Table IV-6. PAH Concentration (ug/kg Wet Weight) in _Spartina foliosa_ in Marine Mesocosms

PAH	PSC2 COMP*	MR COMP*	MR REP 3	FVP REP 1	FVP REP2	FVP REP 3
Acenaphthene	<6.94	**4.18**	**1.05**	<0.96	<1.07	**4.18**
Acenaphthylene	<3.75	<3.81	**1.75**	**3.49**	<1.99	<4.75
Anthracene	<0.42	<3.04	<0.18	<0.4	<0.33	<1.37
Benzo (a) Anthracene	<0.6	<5.08	<0.12	<0.82	<0.49	**4.92**
Benzo (b) Fluoranthene	<5.24	<5.19	<1.08	**1.74**	<1.03	**8.7**
Benzo (k) Fluoranthene	<4.39	<4.34	<0.91	**1.56**	<0.94	**4.85**
Benzo (a) Pyrene	<4.57	<4.52	<0.94	<1.28	<1.31	<3.81
Benzo (g,h,i) Perylene	<7.42	<7.35	<3.93	<2.08	<2.13	<4.37
Chrysene	<1.2	<9.02	<0.48	**1.15**	<0.64	**7.23**
Dibenzo (a,h) Anthracene	<3.72	<3.69	<0.77	<1.04	<1.07	<3.11
Fluoranthene	**3.04**	<2.29	**1.61**	**3.22**	**2.02**	**12.86**
Fluorene	<0.92	<1.7	<0.65	<0.66	<0.65	<1.91
Indeno-1,2,3-c,d Pyrene	<5.48	<5.42	<1.13	<1.53	<1.57	<4.21
Naphthalene	<7.07	B	B	B	B	B
Phenanthrene	**3.53**	**3.36**	<2.25	**2.13**	**2.75**	**6.72**
Pyrene	<3.29	<0.57	**1.69**	**3.75**	**2.23**	**13.96**

B = Compound present in blanks
* Individual replicates with insufficient biomass were composited to permit chemical analysis.

Table IV-7. PAH Concentration in *Salicornia subterminalis* in Marine Mesocosms (Concentration in ug/kg Wet Weight)

PAH	PSC2 COMP	PSC3 COMP	WRC1 REP 2	WRC1AD REP 1	MR REP 1	MR REP 2	FVP REP 3
Acenaphthene	<0.99	<3.46	**1.46**	<2.6	<1.92	<1.89	**0.45**
Acenaphthylene	<6.37	<6.4	<1.41	<1.56	<1.53	<3.49	<2.51
Anthracene	<0.27	<2.83	<0.28	<0.28	<0.23	<0.13	<0.76
Benzo (a) Anthracene	<0.38	<0.51	<0.27	<0.42	<0.33	<0.19	<1.45
Benzo (b) Fluoranthene	<4.81	<4.83	<1.97	<3.95	<2.77	**2.64**	<1.47
Benzo (k) Fluoranthene	<4.03	<4.04	<1.65	<3.31	<2.32	<2.21	<0.89
Benzo (a) Pyrene	<4.19	<4.21	<1.71	<3.44	<2.42	<2.3	<1.65
Benzo (g,h,i) Perylene	<6.82	<6.85	<2.79	<5.6	<3.93	<3.74	<2.69
Chrysene	<0.7	<0.78	<0.57	<0.82	<0.85	**2.03**	<0.62
Dibenzo (a,h) Anthracene	<3.42	<3.43	<1.4	<2.81	<1.97	<1.87	<3.34
Fluoranthene	<1.83	<1.87	**1.94**	**2.68**	**2.27**	**1.69**	**7.03**
Fluorene	<1.24	<1.07	<0.92	<1.03	<1.06	<0.76	<0.42
Indeno-1,2,3-c,d Pyrene	<5.03	<5.05	<2.06	<4.13	<2.9	<2.76	<1.98
Naphthalene	<6.5	<6.52	<2.66	<5.33	B	B	B
Phenanthrene	**3.19**	**3.73**	**3.16**	**2.88**	<0.23	**2.94**	**1.73**
Pyrene	<1.7	<1.65	**1.65**	<2.31	<1.59	<1.01	**6.6**

B = Compound present in blanks
* Replicates not listed are those for which sufficient biomass was not available for chemical analysis.

Table IV-8. PAH Concentration (ug/kg Wet Weight) in _Salicornia subterminalis_ in Estuarine Mesocosms

PAH	PSC2 REP 1	PSC2 REP 2	PSC3 REP 1	PSC3 REP 2	PSC3 REP 3	WRC1 REP 1	WRC1 REP 2
Acenaphthene	**1.3**	**0.82**	**0.83**	**0.78**	<3.83	<1.15	<0.54
Acenaphthylene	<0.74	<1.06	<1.17	<0.68	<7.1	<1.02	<2.53
Anthracene	<0.24	<0.23	<0.29	<0.27	<0.48	<0.33	<0.31
Benzo (a) Anthracene	<0.28	<0.35	<0.38	<0.33	<0.56	<0.38	<0.37
Benzo (b) Fluoranthene	<1.43	<0.1	<0.1	<0.1	<5.35	<1.62	<1.91
Benzo (k) Fluoranthene	<1.2	<0.84	<0.83	<0.83	<4.49	<3.31	<1.35
Benzo (a) Pyrene	<1.25	<0.87	<0.87	<0.87	<4.67	<3.44	<1.41
Benzo (g,h,i) Perylene	<2.03	<1.42	<1.41	<1.41	<7.59	<5.6	<2.29
Chrysene	<0.71	**0.8**	**0.87**	**0.89**	<1.55	<0.82	<0.81
Dibenzo (a,h) Anthracene	<1.02	<0.71	<0.71	<0.71	<3.81	<2.81	<1.15
Fluoranthene	**3.8**	**3.63**	**3.51**	**3.28**	**4.9**	**2.68**	**4.13**
Fluorene	<0.7	<0.51	<0.48	<0.44	<1.11	<1.03	<0.78
Indeno-1,2,3-c,d Pyrene	<1.5	<1.05	<1.04	<1.04	<5.6	<4.13	<1.69
Naphthalene	<1.94	<1.35	<1.35	<1.34	<7.23	<5.33	<2.19
Phenanthrene	**3.16**	**3.17**	**3.19**	**2.81**	**6.06**	**2.88**	**3.7**
Pyrene	**2.39**	**1.77**	**2.32**	**2.22**	<2.7	<2.31	**2.99**

B = Compound present in blanks
* Individual replicates with insufficient biomass were composited to permit analysis.

Table IV-8. Concluded. PAH Concentration (ug/kg Wet Weight) in *Salicornia subterminalis* in Estuarine Mesocosms

PAH	ER REP 1	ER REP 2	ER REP 3	SAND REP 1	SAND REP 2	SAND REP 3
Acenaphthene	<0.71	<1.04	<1.75	<1.93	<3.74	<2.21
Acenaphthylene	<3.57	<0.44	<3.25	<3.57	<6.92	<9.63
Anthracene	<0.56	<0.3	<0.52	<0.56	<0.38	<0.49
Benzo (a) Anthracene	<1.01	<0.6	<0.58	<1.01	<0.27	<0.43
Benzo (b) Fluoranthene	<2.69	<0.99	<2.45	<2.69	<5.22	<7.27
Benzo (k) Fluoranthene	<2.26	<0.83	<2.05	<2.26	<4.37	<6.09
Benzo (a) Pyrene	<2.35	<0.83	<2.14	<2.35	<4.55	<6.34
Benzo (g,h,i) Perylene	<3.82	<0.71	<3.48	<3.82	<7.4	<10.31
Chrysene	<1.47	**1.01**	<0.8	<1.47	<0.94	<1.27
Dibenzo (a,h) Anthracene	<1.92	<0.71	<1.74	<1.92	<3.71	<5.17
Fluoranthene	**5.75**	**4.08**	**4.27**	**5.75**	**4.24**	**4.59**
Fluorene	<0.69	<0.48	<0.4	<0.69	<0.7	<1.56
Indeno-1,2,3-c,d Pyrene	<2.82	<1.04	<2.56	<2.82	<5.46	<7.6
Naphthalene	B	B	B	B	B	B
Phenanthrene	**4.16**	**3.63**	**3.64**	**4.16**	**4.97**	**7.21**
Pyrene	**3.3**	**1.42**	**2.61**	**3.3**	<2.7	<2.9

B = Compound present in blanks

Table IV-9. Pesticide Concentrations (ug/kg Wet Weight) in _Spartina foliosa_ from Marine Mesocosms

Pesticide	Substrate					
	PSC2 COMP	MR COMP	MR REP 3	FVP REP 1	FVP REP 2	FVP REP 3
a-BHC	<0.429	<0.425	**0.312**	**0.217**	<0.123	<0.358
b-BHC	<0.429	<0.425	<0.089	<0.12	<0.123	<0.358
d-BHC	<1.303	<0.435	<0.089	<0.12	<0.123	<0.358
Lindane	**5.092**	**2.14**	**1.953**	**0.721**	**6.354**	<0.358
Heptachlor	<0.877	<0.868	<0.181	<0.12	<0.251	<0.731
Aldrin	**1.001**	**1.858**	**0.262**	<0.245	**0.322**	**1.445**
Heptachlorepoxide	<0.48	<0.476	<0.099	**0.528**	**0.131**	<0.401
Endosulfan Sulfate	**2.179**	<1.217	<0.254	<0.134	<0.352	<1.026
a-Endosulfan	**0.415**	**1.809**	**0.272**	<0.344	**0.279**	**1.426**
Dieldrin	<4.472	<4.428	<0.924	**0.351**	<1.282	<3.734
Endrin	<4.427	<4.176	<0.872	<1.251	<1.209	<3.522
b-Endosulfan	<1.229	<1.217	<0.254	**0.238**	<0.352	<1.026
Endrin Aldehyde	<1.229	<1.217	**0.555**	<1.18	<0.352	<1.026
Toxaphene	<12.289	<12.169	<2.54	<3.439	<0.523	<10.261
pp DDE	<0.584	<0.579	<0.121	**0.238**	<0.167	<0.488
pp DDD	<0.598	<0.286	<0.06	<0.344	<0.083	<0.241
pp DDT	<0.901	**4.263**	<0.06	<0.252	**1.14**	<0.753
Chlordane	<12.289	<12.169	<2.54	<3.439	<3.523	<10.261

Table IV-10. Pesticide Concentrations (ug/kg Wet Weight) in <u>Salicornia</u> <u>subterminalis</u> from Marine Mesocosms

Pesticide	Substrate						
	PSC2	PSC3	WRC1	WRCIAD	MR	MR	FVP
	COMP	COMP	REP 1	REP 2	REP 1	REP 2	REP
a-BHC	**0.516**	<0.395	<0.161	<0.323	<0.227	<0.216	**0.381**
b-BHC	<0.394	<0.395	<0.161	<0.323	<0.227	<0.216	<0.155
d-BHC	<0.394	<0.395	<0.161	<0.323	<0.227	<0.216	<0.155
Lindane	**5.614**	**6.381**	**0.654**	**1.301**	**3.479**	**4.028**	**1.65**
Heptachlor	<0.805	<0.809	<0.329	<0.661	<0.465	<0.441	**0.884**
Aldrin	**0.897**	**0.752**	**0.542**	**0.664**	**0.776**	**0.488**	**1.449**
Heptachlorepoxide	**0.384**	**0.272**	**0.536**	<0.362	<0.255	<0.242	**2.06**
Endosulfan Sulfate	<1.129	<1.133	<0.461	<0.926	<0.618	<0.618	<0.445
a-Endosulfan	**0.705**	**0.898**	**0.704**	**1.174**	**0.987**	**0.542**	**0.654**
Dieldrin	<4.107	<4.123	<0.082	<3.371	<2.234	<2.251	<1.619
Endrin	<3.873	<3.889	<1.583	<3.179	<2.369	<2.123	**0.278**
b-Endosulfan	**0.231**	<1.133	<0.119	<0.926	<2.234	<0.618	**0.716**
Endrin Aldehyde	<1.129	<1.133	<0.461	<0.926	<0.651	<0.618	<0.445
Toxaphene	<11.286	<11.331	<4.613	<9.264	<6.511	<6.185	<4.45
pp DDE	<0.537	<0.539	**1.238**	**1.065**	**1.155**	**0.564**	**0.644**
pp DDD	<0.265	<0.266	**0.348**	<0.218	<0.153	<0.145	**0.512**
pp DDT	<0.828	<0.831	<0.338	<0.68	<0.478	<0.454	<0.326
Chlordane	<11.288	<11.331	<4.613	<9.264	<6.511	<6.185	<0.445

Table IV-11. Pesticide Concentrations (ug/kg Wet Weight) in _Salicornia subterminalis_ from Estuarine Mesocosms

Pesticide	**Substrate**						
	PSC2 REP 1	PSC2 REP 2	PSC3 REP 1	PSC3 REP 2	PSC3 REP 3	WRC1 REP 1	WRC1 REP 2
A-BHC	<0.117	**0.155**	<0.082	<0.081	<0.438	<0.132	<0.156
B-BHC	<0.117	**2.531**	<0.082	<0.081	<0.438	<0.132	<0.156
D-BHC	<0.117	<0.082	<0.082	<0.081	<0.438	<0.132	<0.156
Lindane	**0.503**	**1.099**	**0.703**	**0.691**	**5.836**	**0.665**	**4.89**
Heptachlor	<0.24	<0.168	<0.167	<0.167	<0.897	<0.132	<0.319
Aldrin	<0.442	<0.08	<0.08	<0.232	**0.754**	<0.65	**0.375**
Heptachlorepoxide	<0.131	<0.092	<0.091	<0.091	<0.491	<0.291	<0.176
Endosulfan Sulfate	<0.336	<0.235	**0.257**	<0.234	<1.257	<0.38	<0.448
A-Endosulfan	**0.762**	**0.682**	**0.552**	**0.512**	**0.877**	**0.756**	**0.419**
Dieldrin	<1.223	<0.118	<0.85	<0.137	<4.573	<0.584	**0.128**
Endrin	<1.154	<0.807	<0.802	<0.802	<4.313	<0.215	<1.537
B-Endosulfan	<0.336	<0.235	<0.234	<0.234	<0.222	<0.153	<0.448
Endrin Aldehyde	<0.336	<0.235	<0.234	<0.234	<1.257	<0.38	<0.448
Toxaphene	<3.361	<2.353	<2.337	<2.335	<12.567	<3.795	<4.447
PP DDE	<0.889	<0.674	<0.636	<0.492	**0.894**	<0.729	<0.213
PP DDD	<0.079	<0.055	**0.055**	**<0.055**	<0.184	<0.195	<0.105
PP DDT	<0.247	<0.173	<0.171	<0.171	**<0.992**	<0.661	<0.328
Chlordane	<2.158	<5.231	<2.283	<23.088	<2.227	<2.322	<4.447

Table IV-11. Concluded. Pesticide Concentrations (ug/kg Wet Weight) in Mesocosms *Salicornia subterminalis* from Estuarine

Pesticide	Substrate					
	ER REP 1	ER REP 1	ER REP 2	SA REP 1	SA REP 2	SA REP 3
A-BHC	<0.081	<0.196	<0.210	<0.22	<0.427	**0.441**
B-BHC	<0.081	<0.106	<0.201	<0.22	<0.427	<0.595
D-BHC	<0.081	<0.106	<0.201	<0.22	<0.427	<0.595
Lindane	**0.966**	**0.558**	**2.011**	**1.183**	**4.666**	**3.887**
Heptachlor	<0.166	<0.217	<0.41	<0.451	<0.874	<1.217
Aldrin	**0.314**	**0.362**	**0.374**	**0.464**	**0.796**	**1.177**
Heptachlorepoxide	<0.091	<0.119	<0.225	<0.247	<0.479	<0.667
Endosulfan Sulfate	<0.233	<0.304	<0.575	<0.632	<1.225	<1.706
A-Endosulfan	**0.645**	**0.465**	**0.535**	**0.73**	**0.753**	**1.503**
Dieldrin	<0.848	**0.139**	**0.121**	**0.387**	**0.488**	**0.426**
Endrin	<0.799	<1.043	<1.974	<2.169	<4.203	<5.853
B-Endosulfan	<0.233	<0.304	**0.245**	<0.632	<1.225	<1.706
Endrin Aldehyde	<0.233	<0.304	<0.575	<0.632	<1.225	<1.706
Toxaphene	<2.329	<3.038	<5.752	<6.32	<12.248	<17.056
PP DDE	**1.244**	**0.743**	**0.615**	**0.899**	**1.043**	**1.66**
PP DDD	<0.055	<0.071	<0.135	<0.149	**0.362**	<0.401
PP DDT	<0.171	<0.223	<0.422	<0.464	<0.899	<1.251
Chlordane	<2.329	<3.038	<0.742	<6.32	<12.248	<17.056

Table IV-12. PCB Concentrations (ug/kg Wet Weight) in Mesocosm Plants

Substrate	Salinity	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Spartina					
PSC3 COMP	M	<19.059	<19.059	<19.059	<19.059
PSC3 REP 1	M	<16.974	<16.974	<16.974	<16.874
WRC1 REP 1	M	<4.613	<4.613	<4.613	<4.613
MR COMP	M	<12.169	<12.169	<12.169	<12.169
MR REP 3	M	<2.54	<2.54	<2.54	<2.54
FVP REP 1	M	<3.439	<3.439	<3.439	<3.439
FVP REP 2	M	<3.523	<3.523	<3.523	<3.523
FVP REP 3	M	<10.261	<10.261	<10.261	<10.261
Salicornia					
PSC2 COMP^	M	<11.286	<11.286	<11.286	<11.286
PSC2 REP 1	E	<3.361	<3.361	<3.361	<3.361
PSC2 REP 2	E	<2.353	<2.353	<2.353	<2.353
PSC3 COMP	M	<11.131	<11.131	<11.131	<11.131
PSC3 REP 1	M	<11.03	<11.03	<11.03	<11.03
PSC3 REP 1	E	<2.227	<2.227	<2.227	<2.227
PSC3 REP 2	E	<2.232	<2.232	<2.232	<2.232
PSC3 REP 3	E	<7.737	<7.737	<7.737	<7.737
WRC1 REP 1	E	<3.795	<3.795	<3.795	<3.795
WRC1AD REP 2	M	<9.264	<9.264	<9.264	<9.264
MR REP 1	M	<6.511	<6.511	<6.511	<6.511
MR REP 2	M	<6.185	<6.185	<6.185	<6.185
FVP REP 3	M	<4.45	<4.45	<4.45	<4.45
SA REP 1	E	<6.32	<6.32	<6.32	<6.32
SA REP 2	E	<12.248	<12.248	<12.248	<12.248
SA REP 3	E	<17.056	<17.056	<17.056	<17.056
ER REP 1	E	<2.329	<2.329	<2.329	<2.329
ER REP 2	E	<3.038	<3.038	<3.038	<3.038
ER REP 3	E	<5.752	<5.752	<5.752	<5.752

* : Replicates are those with sufficient tissue for chemical analysis.
^ : Composites are composed of replicates with insufficient biomass for analysis.
M : Marine
E : Estuarine

Table IV-13. Butyltin Concentration (ug/kg Dry Weight) in Mesocosm Plants

Site	Species	Salinity	Tetrabutyl Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
PSC2 REP 1	Salicornia	Estuarine	-	<38.3	<18.1	<4.3
PSC2 REP 2	Salicornia	Estuarine	-	<38.3	<18.1	**12.1**
PSC3 REP 1	Salicornia	Estuarine	-	<38.3	<18.1	<10.2
WRC1 REP 1	Salicornia	Estuarine	-	<38.3	<6.9	<9.7
WRC1 REP 1	Spartina	Marine	-	<38.3	<18.1	<8.0

Table IV-14. Survival of Snails (*Nassarius*) and Mussels (*Modiolus*) for chemical analysis from Marine Mesocosms

Sediment/soil	Rep	Snails Recovered Alive from Original 35		Mussels Recovered Alive from Original 15	
		Rep	Mean	Rep	Mean
PSC2	1	11		12	
	2	30	23.3 ab+	15	14.0 ab
	3	29		15	
PSC3	1	19		15	
	2	25	30.3 a	15	15.0 a
	3	47**		15	
WRC1	1	5		15	
	2	35	17.3 ab	14	14.7 a
	3	12		15	
WRC1AD	1	0		15	
	2	34	12.0 ab	14	14.3 a
	3	2		14	
Sand	1	0		15	
	2	37	20.3 ab	15	15.0 a
	3	24		15	
Site 1 Ref*	1	0		10	
	2	7	2.3 b	10	10.7 c
	3	0		12	
FVP Ref^	1	20		13	
	2	-	19.5 ab	12	12.7 b
	3	19		13	

\+ Means followed by different letters within a column are statistically different at P = 0.05.
* Field Survey Site 1.
^ Black Rock Harbor Contaminated Reference.
** Apparently Received an Additional 12 Snails in Error.

Table IV-15. Survival of Snails (Nassarius) and Mussels (Modiolus) for chemical analysis from Estuarine Mesocosms

Sediment/soil	Rep	Snails Recovered Alive from Original 35	
		Rep	Mean
PSC2	1	21	
	2	34	21.3 a**
	3	9	
PSC3	1	26	
	2	20	21.3 a
	3	18	
WRC1	1	30	
	2	11	23.7 a
	3	30	
Sand	1	6	
	2	35	19.0 a
	3	16	
Site 14 Ref*	1	13	
	2	23	12.0 a
	3	0	

* Field Survey Site 14.
** Means followed by similar letter is within this column are not statistically different at P = 0.05.

Table IV-16. Mean Heavy Metal Concentrations (ug/g Dry Weight) in Marine Mesocosm Snails

Site	Cr	Ni	Cu	Zn*	As	Se	Cd	Hg	Pb
PSC2	<12.1 b**	**13.2 a**	**2975 a**	**473.0 a**	**25.3 a**	**5.4 a**	**4.3 a**	**0.8 a**	**2.6 b**
PSC3	<17.5 b	**17.4 a**	**2385 a**	**386.5 a**	**25.7 a**	**4.8 a**	**5.2 a**	**0.8 a**	**2.6 b**
WRC1	<21.0 b	**15.9 a**	**1234 a**	**282.5 a**	**15.7 a**	**2.2 a**	**1.9 a**	**0.4 a**	<3.0 b
WRC1AD	<18.0 b	**9.9 a**	**2245 a**	**340.5 a**	**19.7 a**	**4.2 a**	**3.0 a**	**0.7 a**	<2.4 b
FVP REF	<16.5 b	**19.8 a**	**2650 a**	**487.0 a**	**26.7 a**	**5.0 a**	**3.2 a**	**0.5 a**	**5.0 b**
Sand	<17.5 b	**13.3 a**	**1840 a**	**300.0 a**	**19.1 a**	**4.3 a**	**1.8 a**	**0.6 a**	**2.4 b**
MR	<17.0 b	**13.9 a**	**1701 a**	**295.0 a**	**21.7 a**	**4.1 a**	**4.6 a**	**0.2 a**	**3.1 b**
BACKGROUND	**59.6 a**	**11.1 a**	**3685 a**	**767.5 a**	**17.2 a**	**4.8 a**	**1.5 a**	**0.2 a**	**26.6 a**

*: Pr > F = 0.0609 for these means.
**: Means followed by similar letters within a column are not statistically different at P = 0.05, unless otherwise noted.

Table IV-17. Mean Heavy Metal Concentrations (*ug/g* Dry Weight) in Estuarine Mesocosm Snails

Site	Cr*	Ni	Cu	Zn	As	Se	Cd	Hg	Pb^
PSC2	**10.0 b**	**5.3 b****	**3120 a**	**483.5 a**	**27.6 a**	**6.1 a**	**3.8 a**	**0.6 a**	**2.6 ab**
PSC3	<14.5 ab	**5.9 b**	**2420 a**	**449.0 a**	**22.7 a**	**4.7 a**	**2.7 a**	**0.5 a**	<2.1 b
WRC1	<9.9 b	**7.8 b**	**3265 a**	**507.0 a**	**27.0 a**	**6.3 a**	**4.3 a**	**0.7 a**	<1.9 b
Sand	**12.3 b**	**7.9 b**	**3190 a**	**483.5 a**	**17.2 a**	**6.0 a**	**4.1 a**	**0.7 a**	<2.0 b
ER	**19.0 a**	**17.1 a**	**1951 a**	**310.0 a**	**20.3 a**	**4.0 a**	**1.0 a**	**0.3 a**	**2.9 a**

*: Pr > F = 0.0762 for these means.
^: Pr > F = 0.0710 for these means.
**: Means followed by different letters within a column are statistically different at P = 0.05, unless otherwise noted.

Table IV-18. Mean Heavy Metal Concentrations (ug/g Dry Weight) in Marine Wetland Mesocosm Mussels

Site	Cr	Ni	Cu	Zn	As	Se	Cd	Hg	Pb	Ag
PSC2	<7.1 b*	**1.7 b**	**13.6 b**	**54.1 c**	**11.4 a**	**2.0 a**	**2.1 b**	**0.05 b**	<1.5 b	**0.63 a**
PSC3	<7.6 b	<1.6 b	**12.7 b**	**52.1 c**	**11.7 a**	**1.8 a**	**2.2 b**	**0.06 b**	<1.6 b	**0.77 a**
WRC1	<7.0 b	<1.2 cd	**12.1 b**	**49.5 c**	**11.1 a**	**1.6 a**	**2.1 b**	**0.08 ab**	<1.6 b	**1.38 a**
WRC1AD	<7.1 b	<1.3 cd	**14.5 b**	**53.9 c**	**11.9 a**	**1.7 a**	**2.5 b**	**0.10 ab**	<1.6 b	**0.95 a**
MR	<7.4 b	**1.4 c**	**15.2 b**	**54.1 c**	**12.0 a**	**1.7 a**	**1.8 b**	**0.12**	<1.6 b	**0.92 a**
FVP	**11.3 a**	**2.6 a**	**76.5 a**	**98.7 a**	**8.6 c**	**1.6 a**	**2.4 b**	**0.04 b**	**6.6 a**	**1.39 a**
Sand	<7.7 b	<1.3 cd	**14.7 b**	**55.1 c**	**10.7 ab**	**1.5 a**	**3.0 a**	**0.05 b**	<1.6 b	**0.87 a**
BK	**5.3 c**	**1.1 d**	**14.6 b**	**63.6 b**	**9.4 bc**	**1.9 a**	**1.1 c**	**0.07 b**	<1.3 b	**1.19 a**

*: Means followed by different letters within a column are statistically different at P = 0.05, unless otherwise noted.

Table IV-19. Mean Butyltin Concentrations (ug/kg Wet Weight) in Mussels in Marine Mesocosms

	Substrate		Tetrabutyl	Tributyl
Dibutyl	Monobutyl Tin	Tin	Tin	Tin
PSC2	<5.7 a*	**7.5 a**	<3.4 a	<3.4 a
PSC3	<5.3 a	**7.6 a**	**6.2 a**	<3.2 a
WRC1	<4.3 a	**9.9 a**	<2.6 a	<2.6 a
WRC1AD	<4.2 a	**5.1 a**	**5.7 a**	<2.5 a
MR	<4.7 a	<4.5 a	<2.9 a	<2.9 a
SAND	<4.6 a	**8.4 a**	**6.6 a**	<2.8 a
BK	<7.9 a	**13.2 a**	<4.9 a	<4.8 a

*: Means followed by different letters within a column are statistically different at
P = 0.05, unless otherwise noted.

Table IV-20. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in mg/kg metals and ug/kg butyltins)**

	Estuarine Sites: 1 - 8		Freshwater Sites: 9, 10, and 14		Marine Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
As: Modiolus	8.85	8.76 - 8.93	NA	NA	NA	NA
Cerithidea	7.78	2.5 - 11.62	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	10.79	10.79@
Cr: *Modiolus*	3.65	3.3 - 4.0	NA	NA	NA	NA
Cerithidea	1.83	1.2 - 2.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	4.3	4.3@
Cu: *Modiolus*	21.85	20.5 - 23.1	NA	NA	NA	NA
Cerithidea	63.8	23.5 - 93.6	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	164.1	164.1@
Ni: *Modiolus*	6.54	5.33 - 7.74	NA	NA	NA	NA
Cerithidea	7.73	4.5 - 10.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	5.78	5.78@
Pb: *Modiolus*	1.55	1.39 - 1.71	NA	NA	NA	NA
Cerithidea	1.22	0.82 - 1.43	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	1.89	1.89@
Se: *Modiolus*	3.86	3.52 - 4.19	NA	NA	NA	NA
Cerithidea	1.28	1.04 - 1.47	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	3.98	3.98@
Zn: *Modiolus*	71.4	71.1 - 71.7	NA	NA	NA	NA
Cerithidea	280.5	131.4 - 309	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	273.0	273.0@
Cd: *Modiolus*	3.49	3.45 - 3.53	NA	NA	NA	NA
Cerithidea	0.80	0.34 - 1.03	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	3.34	3.34@
Hg: *Modiolus*	0.351	0.304 - 0.398	NA	NA	NA	NA
Cerithidea	0.136	0.055 - 0.180	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	0.469	0.469@
Butyltins						
Tetrabutyltin						
Modiolus	<4.45$	<3.9 - <5.0	NA	NA	NA	NA
Cerithidea	<1.00$	<0.6 - <1.4	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	14.6	14.6@
Tributyltin						
Modiolus	36.6	34.9 - 38.3	NA	NA	NA	NA
Cerithidea	2.2	1.4 - 3.5	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	40.7	40.7@

** : Dry-weight basis for metals; wet-weight for butyltins.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.
Note : There were no animals analyzed from the estuarine sites.

Table IV-20 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)**

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Butyltins						
Dibutyltin						
Modiolus	7.15*	<5.0 - 9.3	NA	NA	NA	NA
Cerithidea	2.55	0.9 - 4.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	30.1	30.1@
Monobutyltin						
Modiolus	6.2*	<4.6 - 7.8	NA	NA	NA	NA
Cerithidea	1.65	1.6 - 1.7	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	11.8	11.8@
PCBs						
Aroclor 1016						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1221						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1232						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1242						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1248						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1254						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@
Aroclor 1260						
Modiolus	<100$	<100@	NA	NA	NA	NA
Cerithidea	<100$	<100@	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100$	<100@

** : Note - there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table IV-20 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[**]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PAHs						
Acenaphthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Acenaphthylene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [a] Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [b] Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [k] Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [a] Pyrene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [g,h,i] Perylene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]

** : Note; there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table IV-20 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[**]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
PAHs	Mean	Range	Mean	Range	Mean	Range
Chrysene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	10.5[*]	<10 - 11	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Dibenzo [a,h] Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Fluorene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Indeno-1,2,3-pyrene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
2-Methyl-Naphthalene						
Modiolus	37.5[*]	<30 - 45	NA	NA	NA	NA
Cerithidea	<30[$]	<30[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	NA	NA
Naphthalene						
Modiolus	90.5[*]	61 - 120	NA	NA	NA	NA
Cerithidea	<60[$]	<60[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Phenanthrene						
Modiolus	25.5	14 - 37	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Pyrene						
Modiolus	18[*]	<10 - 26	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]

** : Note; there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table IV-20 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[**]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
Pesticides	Mean	Range	Mean	Range	Mean	Range
Aldrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
a-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
b-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<12[$]	<12[@]
d-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<24[$]	<24[@]
g-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Chlordane						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
4,4-DDD						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
4,4-DDE						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<115[$]	<115[@]
4,4-DDT						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<30[$]	<30[@]
Dieldrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<16[$]	<16[@]

** : Note; there were no animals analyzed from the estuarine sites.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table IV-20 Concluded. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg wet-weight)[**]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
Pesticides	Mean	Range	Mean	Range	Mean	Range
Endosulfan I						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endosulfan II						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endosulfan Sulfate						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	18[$]	18[@]
Endrin Aldehyde						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Heptachlor						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	42[$]	42[@]
Heptachlor Epoxide						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Methoxychlor						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Toxaphene						
Modiolus	<500[$]	<500[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	NA	NA

[**] : Note; there were no animals analyzed from the estuarine sites.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table IV-21. PCB Concentrations in Mussels from Marine Mesocosms (ug/kg Wet Weight)

Substrate		Aroclor 1242	1248	1254	1260
FVP	REP 1	<5.024	<5.024	**212.440**	<5.024
FVP	REP 3	<3.537	<3.537	**271.582**	<5.537
SAND	REP 1	<2.515	<2.525	**29.830**	<2.525
SAND	REP 2	<2.284	<2.284	**32.916**	<2.284
SAND	REP 3	<2.337	<2.337	**39.749**	<2.337
MR	REP 1	<2.344	<2.344	**36.501**	<2.344
MR	REP 2	<2.316	<2.316	**19.203**	<2.316
BK	REP 1	<8.976	<8.976	**86.037**	<8.976
BK	REP 2	<5.646	<5.646	**91.711**	<5.646

Table IV-22. PAH Concentration (ug/kg Wet Weight) in Mussels in Marine Mesocosms

PAH	PSC2 REP 1	PSC2 REP 2	PSC2 REP 3	PSC3 REP 1	PSC3 REP 2	PSC3 REP 3	WRC1 REP 1	WRC1 REP 2	WRC1 REP 3	WRC1AD REP 1	WRC1AD REP 2	WRC1AD REP 3
Naphthalene	**63.56**	**172.2**	**89.57**	**70.86**	**111.2**	**83.17**	**107.9**	**63.26**	**93.91**	**110.8**	**96.65**	**98.14**
Acenaph-thylene	<0.71	**5.91**	**2.22**	**1.36**	**2.23**	**1.26**	**2.58**	**1.53**	**2.89**	<1.03	**2.95**	**1.96**
Acenaph-thene	**1.78**	**25.08**	**7.48**	**4.81**	**7.69**	**4.27**	**9.03**	**5.73**	**9.7**	**3.15**	**10.68**	**7.71**
Fluorene	**1.04**	**4.95**	**4.82**	**2.4**	**3.19**	**2.34**	**3.82**	**1.98**	**4.61**	**1.57**	**7.18**	**3.88**
Phenanthrene	**17.79**	**58.88**	**54.75**	**42.73**	**50.29**	**35.11**	**42.44**	**35.5**	**59.14**	**29.29**	**78.5**	**50.18**
Anthracene	<0.23	<0.45	<0.37	<0.22	<0.27	<0.31	**0.82**	<0.23	<0.4	<0.32	**0.65**	<0.38
Fluoranthene	**0.74**	<0.99	**0.61**	**0.88**	**0.84**	**0.59**	**2.07**	**0.85**	**1.22**	**1.95**	**2.24**	**1.55**
Pyrene	**1.61**	**5.62**	**1.93**	**1.78**	**2.68**	**2.52**	**4.27**	**2.08**	**4.58**	**6.05**	**6.75**	**5.78**
Benzo (a) Anthracene	<0.14	<0.37	<0.15	<0.14	<0.31	<0.12	<0.29	<0.11	<0.15	<0.32	<0.3	<0.36
Chrysene	<0.22	<0.52	<0.24	<0.35	<0.25	<0.28	**0.74**	<0.28	<0.35	**0.73**	<0.59	**0.79**
Benzo (b) Fluoranthene	<0.99	<0.3	<0.09	<0.13	<0.07	<0.95	<0.32	<0.19	<0.16	<0.34	<0.31	<0.39
Benzo (k) Fluoranthene	<0.83	<0.18	<0.08	<0.13	<0.06	<0.79	<0.17	<0.14	<0.13	<0.16	<0.19	<0.19
Benzo (a) Pyrene	<0.86	<2.2	<0.06	<0.84	<0.85	<0.21	<0.12	<0.08	<0.86	<0.11	<0.16	<0.87
Dibenzo (a,h) Anthracene	<1.03	<0.19	<1.03	<1.	<1.02	<0.99	<1.05	<1.05	<1.03	<1.05	<1.01	<1.05
Indeno-1,2,3-c,d Pyrene	<0.7	<1.8	<0.7	<0.68	<0.7	<0.67	<0.71	<0.72	<0.7	<0.72	<0.69	<0.71
Benzo (g,h,i) Perylene	<1.4	<1.04	<1.4	<0.13	<1.39	<0.22	<0.58	<0.37	<0.49	<0.37	<0.87	<0.91

B = Compound present in blanks

Table IV-22. Concluded. PAH Concentration (ug/kg Wet Weight) in Mussels in Marine Mesocosms

PAH	FVP REP 1	FVP REP 3	MR REP 1	MR REP 2	MR REP 3	SAND REP 1	SAND REP 2	SAND REP 3	BK REP 1	BK REP 2
Acenaphthene	**34.32**	**16.29**	**7.55**	**5.85**	**4.08**	**6.87**	**6.47**	**3.83**	**57.2**	**55.63**
Acenaphthylene	**6.27**	**3.05**	**1.87**	**1.75**	<1.11	**2.08**	**1.6**	<1.24	**6.27**	**11.3**
Anthracene	**2.32**	**3.15**	<0.26	<0.19	<0.28	<0.23	<0.36	<0.36	**5.18**	**8.06**
Benzo (a) Anthracene	**10.08**	**19.25**	<0.18	<0.11	<0.12	<0.21	<0.3	<0.67	**7.22**	**5.81**
Benzo (b) Fluoranthene	**12.28**	**19.32**	<0.11	<0.1	<0.07	<0.12	<0.24	<0.62	**6.09**	**4.52**
Benzo (k) Fluoranthene	**7.11**	**13.02**	<0.11	<0.08	<0.07	<0.05	<0.2	<0.36	**3.52**	<1.71
Benzo (a) Pyrene	**4.11**	**7.43**	<0.87	<0.86	<0.85	<0.94	<0.17	<0.12	<1.22	<0.57
Benzo (g,h,i) Perylene	**6.36**	**7.25**	<1.42	<1.4	<0.02	<1.53	<1.38	<0.59	**6.45**	**4.77**
Chrysene	**16.72**	**29.58**	<0.47	<0.23	<0.07	<0.35	<0.39	**1.57**	**10.86**	**10.65**
Dibenzo (a,h) Anthracene	**0.68**	**0.9**	<0.71	<0.7	<0.2	<0.77	<0.2	<0.71	<2.71	<1.71
Fluoranthene	**32.15**	**65.74**	**0.95**	<0.51	**0.65**	**0.81**	**1.29**	**2.65**	**25.77**	**28.6**
Fluorene	**18.07**	**6.02**	**1.81**	**2.37**	**1.4**	**3.77**	<1.9	**1.92**	**40.64**	**46.7**
Indeno-1,2,3-c,d Pyrene	**3.56**	**4.94**	<1.04	<1.03	<1.02	<1.13	<1.02	<1.04	<1.18	<0.69
Napthalene	**167.88**	**87.09**	**100.7**	**69.6**	**73.26**	**99.44**	**89.52**	**49.18**	**243.57**	**224.9**
Phenanthrene	**149.86**	**67.56**	**22.85**	**37.17**	**26.75**	**46.63**	**19.01**	**34.61**	**240.59**	**306.96**
Pyrene	**71.2**	**96.96**	**4.8**	**1.53**	**2.43**	**2.73**	**2.44**	**5.69**	**81.27**	**66.18**

B = Compound present in blanks

Table IV-23. Pesticide Concentrations (ug/kg Wet Weight) in Mussels from Marine Mesocosms

Pesticide	Substrate								
	PSC2 REP 1	PSC2 REP 2	PSC2 REP 3	PSC3 REP 1	PSC3 REP 2	PSC3 REP 3	WRC1 REP 1	WRC1 REP 2	WRC1 REP 3
A-BHC	<0.128	<0.346	<0.081	<0.078	<0.080	<0.077	<0.082	<0.12	<0.137
B-BHC	<0.081	<0.266	<0.081	<0.078	<0.142	<0.077	<0.082	<0.082	<0.081
D-BHC	<0.081	<0.207	<0.081	<0.078	<0.080	<0.077	<0.082	<0.082	<0.081
Lindane	<0.081	<4.167	<0.081	<3.028	<0.080	<0.077	<4.028	<0.082	<0.081
Heptachlor	<0.165	<0.423	<0.165	<0.001	<0.164	<0.071	<0.168	<0.169	<0.165
Aldrin	<0.079	<0.202	<0.079	<0.077	<0.078	<0.076	<0.080	<0.081	**0.079**
Heptachlorepoxide	**1.171**	<0.211	**0.151**	**0.143**	<0.090	**0.115**	**0.122**	**0.239**	**0.148**
Endosulfan Sulfate	**0.429**	**1.121**	**0.432**	**0.518**	**0.537**	**0.644**	**0.528**	**0.564**	**0.463**
A-Endosulfan	**0.268**	<0.586	**0.310**	<0.175	**0.240**	<0.243	<0.336	<0.206	**0.240**
Dieldrin	<0.291	<0.333	**0.269**	**0.244**	<0.215	<0.287	**0.306**	<0.265	<0.328
Endrin	<0.794	<2.033	<0.794	**0.169**	<0.160	<0.146	<0.808	<0.811	<0.794
B-Endosulfan	<0.502	<0.330	<0.575	<0.272	<0.732	**0.526**	<0.377	<0.592	<0.499
Endrin Aldehyde	<0.079	<0.246	**0.778**	<0.094	**0.810**	<0.899	**0.868**	**0.218**	<0.207
Toxaphene	<2.314	<0.925	<2.314	<2.249	<2.294	<2.220	<2.354	<2.363	<2.313
PP DDE	**2.735**	**3.669**	**2.881**	**2.333**	**3.518**	<2.998	**3.204**	<3.114	<3.105
PP DDD	**0.481**	**2.888**	**0.550**	**1.303**	**0.433**	<0.052	**0.443**	**0.391**	<0.323
PP DDT	<0.548	<0.771	<0.744	<0.590	<0.991	**0.495**	<0.553	<0.700	<0.623
Chlordane	<2.314	<5.925	<2.314	<2.249	<2.268	<2.220	<2.354	<2.363	<2.313

Table IV-23. Continued. Pesticide Concentrations (ug/kg Wet Weight) in Mussels from Marine Mesocosms

Pesticide	Substrate							
	WRC1AD REP 1	WRC1AD REP 2	WRC1AD REP 3	WRC1 REP 1	WRC1 REP 2	WRC1 REP 3	BK REP 1	BK REP 2
A-BHC	<0.080	<0.220	<0.082	<0.082	<0.122	<0.137	**0.667**	**0.635**
B-BHC	<0.083	<0.079	<0.082	<0.082	<0.082	<0.081	**0.477**	**0.311**
D-BHC	<0.256	<0.079	<0.140	<0.082	<0.082	<0.081	<0.313	<0.197
Lindane	<2.767	<0.079	<0.082	<4.028	<0.082	<0.081	**6.531**	**8.873**
Heptachlor	<0.169	<0.162	<0.004	<0.168	<0.169	<0.165	<0.641	**0.044**
Aldrin	<0.081	<0.077	<0.080	<0.080	<0.081	**0.079**	<0.306	<0.192
Heptachlorepoxide	**0.132**	**0.116**	**0.110**	**0.122**	**0.239**	**0.148**	<0.351	<0.221
Endosulfan Sulfate	**0.756**	**0.566**	**0.573**	**0.528**	**0.564**	**0.463**	<0.898	**0.786**
A-Endosulfan	<0.227	**0.350**	**0.351**	<0.336	<0.206	**0.240**	**3.243**	**0.420**
Dieldrin	<0.289	<0.266	<0.315	**0.306**	<0.265	<0.328	**1.527**	**1.161**
Endrin	<0.812	<0.086	<0.806	<0.808	<0.811	<0.794	<3.080	<1.938
B-Endosulfan	<0.379	<0.573	<0.537	<0.377	<0.592	<0.499	**0.942**	**0.639**
Endrin Aldehyde	<0.363	**1.012**	**0.537**	**0.868**	**0.218**	<0.207	**1.863**	**1.411**
Toxaphene	<2.367	<2.265	<2.350	<2.354	<2.363	<2.313	<8.976	<5.646
PP DDE	**2.488**	**3.224**	**2.609**	**3.204**	<3.114	<3.105	**6.538**	**5.234**
PP DDD	**2.058**	**0.552**	**0.491**	**0.443**	**0.391**	<0.323	**1.422**	**1.059**
PP DDT	<0.405	<0.609	<0.498	<0.553	<0.700	<0.623	**1.047**	**1.452**
Chlordane	<2.367	<2.265	<2.350	<2.354	<2.363	<2.313	<8.976	<5.646

Table IV-23 Concluded. Pesticide Concentrations (ug/kg Wet Weight) in Mussels from Marine Mesocosms

Pesticide	Substrate							
	MR REP 1	MR REP 2	MR REP 3	SAND REP 1	SAND REP 2	SAND REP 3	FVP REP 1	FVP REP 3
a-BHC	**0.152**	<0.081	**0.153**	<0.088	<0.080	<0.082	**0.365**	**0.577**
b-BHC	<0.082	<0.081	<0.080	<0.088	<0.080	<0.082	**0.847**	<0.123
d-BHC	<0.082	<0.081	<0.080	<0.088	<0.080	<0.082	**0.646**	<0.123
Lindane	<0.082	<0.081	<0.080	**3.407**	**0.140**	2.965	**7.233**	**1.169**
Heptachlor	**0.101**	<0.165	<0.146	<0.180	<0.163	**0.061**	**0.253**	**1.698**
Aldrin	<0.080	<0.079	<0.078	<0.086	<0.078	0.166	<0.172	<0.121
Heptachlorepoxide	**0.270**	**0.201**	**0.095**	**0.124**	**0.204**	**0.213**	<0.197	<0.138
Endosulfan Sulfate	**0.516**	**0.394**	**0.486**	**1.068**	0.638	0.731	0.517	1.431
a-Endosulfan	**0.189**	**0.172**	**0.185**	**0.175**	**0.334**	**0.297**	**2.252**	**2.300**
Dieldrin	**0.429**	**0.233**	**0.372**	**0.244**	**0.266**	0.293	**1.679**	**1.578**
Endrin	<0.804	<0.795	**0.121**	**0.169**	<0.784	<0.802	<1.731	<1.214
b-Endosulfan	**0.619**	**0.274**	**0.718**	**0.523**	**0.440**	0.428	**1.782**	**1.325**
Endrin Aldehyde	**1.078**	**0.347**	<0.229	**0.054**	**0.428**	**0.436**	**5.948**	**5.716**
Toxaphene	<2.344	<2.316	<2.293	<2.525	<2.284	<2.337	<5.042	<3.537
pp DDE	**3.117**	**1.811**	**3.005**	**2.250**	**2.877**	**3.072**	**6.643**	**5.077**
pp DDD	**0.412**	**0.358**	**0.840**	**1.499**	**0.317**	**0.441**	**1.760**	**2.552**
pp DDT	**0.931**	**0.357**	**0.685**	**0.644**	**0.590**	0.478	**1.207**	<0.259
Chlordane	<2.344	<2.316	<2.293	<2.525	<2.284	<2.337	<5.042	<3.537

V. CONCLUSIONS AND RECOMMENDATIONS

John F. Baldwin Ship Channel sediment concentrations of arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium and zinc were in the ranges found in naturally occurring wetlands in the San Francisco Bay area. Baldwin sediment butyltin concentrations are approximately less than 5 ppb and much lower than the sediments previously tested in the Oakland Inner Harbor turning basin.

Baldwin - West Richmond reach sediment contained a level of PAHs above that observed in existing wetland sediments around the San Francisco Bay area and may be of concern. Therefore, further evaluation of this sediment for wetland creation was warranted.

The naturally-occurring wetlands in the San Francisco Bay area and the adjacent estuarine and fresh water areas contain relatively low levels of most metal, PCB, PAH, butyltin, and pesticide contaminants in soil/sediment, plants, and animals. Metals such as lead, chromium and arsenic were elevated in some plants and animals. There is, however, a very depauperate faunal component in all the naturally occurring wetlands surveyed, that may be the result of a more subtle impact.

The plant bioassay test results indicated that leaf tissue concentrations of heavy metals were equal to or below concentrations found in naturally occurring wetlands in the San Francisco Bay area. Test data suggest a potential for migration of plant tissue lead into foodwebs associated with the wetland sites. Plant tissue lead contents in existing wetlands are equal to or higher than proposed guidelines for consumable foodstuff by the World Health Organization (WHO) and may be of concern to the foodwebs associated with these sites in the San Francisco Bay Area. Concentrations of PAHs did not exceed levels found in naturally occurring wetlands and should not be of concern. Butyltin concentrations were determined to be below concentrations in eelgrass growing in a minimally polluted estuary and should not be of concern. Restrictions are generally not required for wetland plants established on Baldwin Harbor sediments. The status of lead in wetland

foodwebs in the San Francisco Bay area should be monitored and further evaluated.

The wetland animal bioassay showed mixed results with plant and animal growth in the mesocosms. While Salicornia grew well in the sediments, Spartina foliosa grew poorly, and Scirpus olynei showed the poorest growth. The time of field collection in the fall may have resulted in severe set back into a dormant stage for Spartina and Scirpus. Placing marine sediments in a brackish estuarine wetland resulted in excess salinity for Scirpus to survive. Snails and mussels grew well in the mesocosms, however, the annelids, Nephtys, died in all mesocosms. A thick algae mat formed on all sediment surfaces and tended to seal the surface and eliminate oxygen penetration from tidal water into sediments, suffocating Nephtys. Another sediment dwelling animal will need to be used in future wetland testing.

The creation of brackish estuarine wetlands with marine sediments will require initially the use of more saline tolerant species like Salicornia. Brackish water species will colonize these sediments only after the salinity has been reduced, which may take years and depends on the tidal flushing occurring at the wetland creation site.

The wetland mesocosm tests indicated that creating wetlands with J.F. Baldwin Project sediments will produce plants with tissue metal concentrations in the range of existing wetlands in the San Francisco Bay area. PAH concentrations in the Salicornia either in marine or estuarine mesocosms were negligible with only Fluoranthene, Phenanthrene, and Pyrene being above detection limits for the Pinole Shoal reach and West Richmond reach sediments, but similar to that observed for the estuarine reference and the sand control reference. Test data indicated no potential for pesticides to accumulate in wetland plants to concentrations that approach or exceed FDA levels considered for animal feed. PCBs and Butyltin were not detected in the plants from either the marine or estuarine mesocosms. Test data suggest the presence of an elevated ambient arsenic, as well as chromium and lead, concentration in the wetland environments in the San Francisco Bay area. Placing J.F. Baldwin

Project sediments in an estuarine wetland mesocosm showed similar results to the marine mesocosm exposures.

Snails collected from the San Francisco Bay area and exposed to J. F. Baldwin sediments did not show accumulation of metals above ambient levels or above reference sediments collected from existing wetlands in the San Francisco Bay area. Test data indicated that the accumulation of butyltins in wetland animals as shown with mussels should not be of concern when wetlands are created with J.F. Baldwin Project sediments. Test data also indicated that PCB uptake by wetland animals should be similar to that existing in the San Francisco Bay area and therefore should not be of concern. Test data suggested that while mussels contained certain PAHs after exposure to Baldwin sediments, the concentrations were probably influenced by the relatively high initial tissue background concentration and should not be of concern.

Mussel tissue pesticide concentrations were present at relatively low levels, near detection limits, for all test sediments, for the marine reference, for the sand control reference and in the initial background tissues of the field collected mussels used in the test. These low levels of pesticides do not appear to represent any concern for foodweb contamination in wetlands created with J.F. Baldwin Project sediments.

In summary, test results indicate that wetland creation with J. F. Baldwin Project sediments will produce wetlands comparable to existing wetlands in the San Francisco Bay area. Wetland plants and animals will contain contaminant levels similar to those of existing wetlands. Restrictions on the use of J. F. Baldwin sediments for wetland creation are not required.

Test data suggest the presence of an elevated ambient arsenic, chromium, and lead concentration in existing San Francisco Bay area wetlands. In addition, the field survey indicated few wetland animals present in all naturally occurring wetlands sampled and suggest a more subtle impact such as the prolonged drought and potential increase in wetland salinities.

Use of J. F. Baldwin sediments for brackish wetland creation will require use of more salt tolerant plant species or sufficient leaching of salt from marine sediment prior to the establishment of brackish water wetland plants.

It is recommended that saltwater (marine) wetlands can be created with J. F. Baldwin sediments and should not be a cause for concern. Creation of brackish water (estuarine) wetlands are not recommended since it requires leaching of salt from the marine sediments to allow brackishwater wetland plants to survive and become established. It may take years of tidal flushing to reduce the salinity to a level that will allow brackishwater plants to survive. Additional research is recommended to identify wetland animal species that are sediment-dwellers and can be used for wetland bioassays. Further evaluation is recommended of the ambient elevated concentrations of arsenic, chromium, and lead in existing San Francisco Bay wetlands and the lack of wetland animals present in wetlands.

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Appendix A
Sediment Collection and Characterization

A1. Cruise Report: Battelle, Pacific NW Laboratories

A2. Chemical Characterization

A3. Physical Characterization

a. Pinole Shoal Reach
b. West Richmond Reach

Appendix A1
Cruise Report: Battelle, Pacific NW Laboratories

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CHEMICAL EVALUATIONS OF JOHN F. BALDWIN SHIP CHANNEL SEDIMENT PHASE II

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EXECUTIVE SUMMARY

In August of 1990, the Battelle/Marine Sciences Laboratory conducted a program of sampling, geological characterization, and chemical analysis of sediments from five sites in the West Richmond reach of the John F. Baldwin Ship Channel in San Francisco Bay. The study was conducted for the U. S. Army Corps of Engineers (USACE), San Francisco District. Additional sediment samples were collected for the USACE Waterways Experiment Station (WES) Wetlands and Uplands testing programs.

The objective of the Battelle study of the five West Richmond sites was to determine the physical characteristics and chemical contaminant levels in sediments proposed for dredging. One core sample from each site was collected to the dredging project depth of -45 ft relative to mean lower low water (MLLW) plus 2 ft of overdepth for a total sampling depth of -47 ft MLLW. Cores from the Phase II West Richmond stations ranged in length from 4.7 to 12.8 ft. Each core was split longitudinally so that one half was used for geological characterization and the other half for chemical analysis. Sediment samples for chemical analysis were prepared by homogenizing the sediment between the sediment surface (mudline) to -47 ft MLLW. These samples were analyzed for trace metals, butyltins, polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), chlorinated pesticides, and sediment conventionals (grain size, total organic carbon, total volatile solids, oil and grease, and petroleum hydrocarbons).

The sediments were described as predominantly dark olive gray sands with interstratified layers of silt and/or clay. Grain size analysis bore this out as all five sediment samples contained more than 50% sand and less than 20% clay. Contaminant levels in the Phase II West Richmond sediments were very low. Metals concentrations were comparable to or lower than those measured in Phase I samples. Butyltin concentrations were very low, with no sample containing more than 2 μg/kg total butyltin. Organic contaminants (PAH, PCB, and pesticides) were not detected in any of the Phase II West Richmond samples. The absence of PAH compounds at three Phase II stations (WR-C, WR-D, and WR-E) was in contrast to total PAH concentrations of 474-3075 μg/kg measured at three nearby Phase I stations (WR V L, WR IV.5 C, and WR IV R). The differences may be explained by the fact that the Phase II stations were located outside the existing channel, 1-2000 ft east of the Phase I stations.

ACKNOWLEDGEMENTS

The authors thank the following people for their assistance on the John F. Baldwin Phase II project: Bruce Bjornstad for his assistance on and review of the geological core descriptions; Mike Hamilton and Maureen Kilpatrick for chemistry data entry; Lyle Hibler and Ray Bienert for Macintosh computer training and support.

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FIGURES

TABLES

1.0 INTRODUCTION

The John F. Baldwin Ship Channel is the major shipping channel in San Pablo Bay that connects San Francisco Bay with Suisun Bay (Figure 1.1). The San Francisco District of the U.S. Army Corps of Engineers (USACE) is responsible for construction and improvement of the John F. Baldwin Ship Channel, authorized by Congress in the Rivers and Harbors Act of 1965 (Public Law 89-298). The John F. Baldwin Channel is approximately 28 miles long, and will be maintained at a project depth of -45 ft relative to mean lower low water (MLLW). To this end, it is estimated that 800,000 cubic yards (cy) of sediment from the West Richmond reach, 7,000,000 cy from the Pinole Shoal reach and 800,000 cy from Carquinez Strait will be dredged and removed from the Channel.

In order to evaluate alternative disposal methods for the dredged sediment, USACE requested Battelle's Marine Sciences Laboratory (MSL) to provide information on chemical and physical characteristics of the sediment. Phase I of MSL's John F. Baldwin Program, conducted in 1989-1990, included sampling, geological description, and chemical analysis of sediment cores collected from 47 sites. The results are published in Chemical Evaluations of John F. Baldwin Ship Channel Sediment (Word & Kohn, 1990). The Phase I study showed little sediment contamination in the John F. Baldwin Channel, except for elevated levels of polynuclear aromatic hydrocarbons (PAH) in the West Richmond Reach and possible elevated levels of trace metals in both Central Pinole Shoal and Carquinez Strait. These Phase I sediment data were used to plan the next phase of John F. Baldwin Ship Channel sediment evaluations.

Phase II of the John F. Baldwin Ship Channel Program was planned with two major objectives in mind. The first was to collect sediment from the relatively uncontaminated northern and western portions of the Pinole Shoal. This sediment would be sent to USACE's Waterways Experiment Station (WES) in Vicksburg, Mississippi, where tests would be conducted to determine acceptability of sediment for the creation of marshes and also evaluated for use in uplands disposal. The second objective was to further examine the

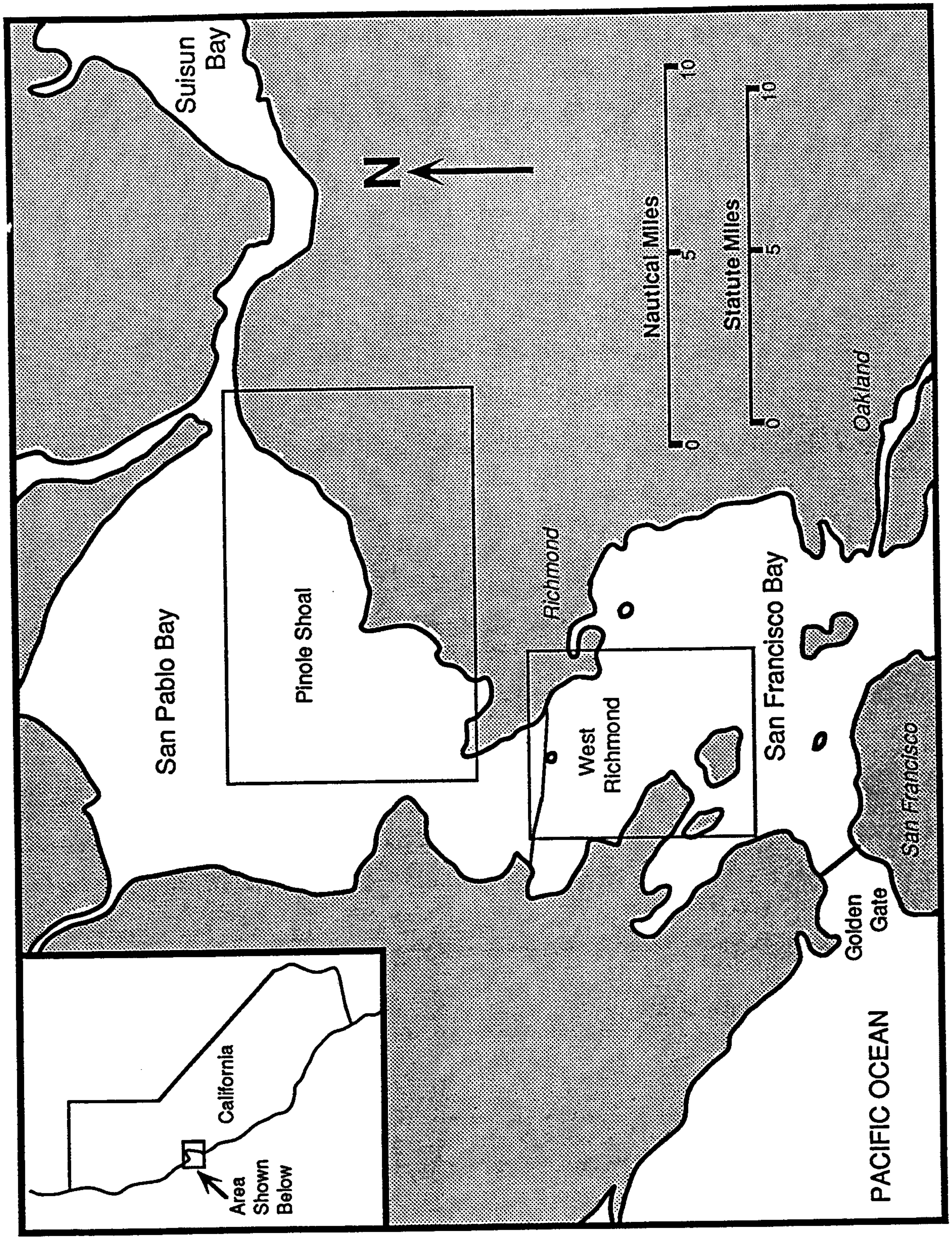

FIGURE 1.1. John F. Baldwin Ship Channel Study Area

1.2

characteristics of sediments in the West Richmond area by collecting and analyzing core samples from five new sites from this reach. The data from the new sites were then compared to data from the West Richmond sites that were sampled in 1989 during Phase I. The results of Phase II sampling and the analysis of West Richmond core samples is presented in this report.

2.0 MATERIALS AND METHODS

2.1 FIELD SAMPLING

The objectives of the field sampling program were to collect sediment and water samples for uplands and wetlands testing to be performed by USACE-WES, and to collect sediment for Battelle's geological and chemical analysis. The WES testing programs required 15 55-gal drums of sediment for each of the testing composites, and 20 gal of water to be used for mixing with these sediments from the relatively uncontaminated areas in the West Richmond and Pinole Shoal reaches of the John F. Baldwin Ship Channel. Because of these large quantities of required sediment, the WES material was collected in the 12-in diameter split core sampler designed specifically for these types of programs and described below. The testing program performed by MSL required relatively undisturbed core samples contained in a noncontaminating tube to maintain the stratigraphy and chemical integrity of the sediment. The coring tool used for this purpose was a 4-in diameter vibratory-hammer core, originally designed to sample Merritt Sand formations in Oakland Harbor (Word et al 1990). All core sampling was conducted from the derrick barge Hagar, a marine construction platform owned and operated by Manson Construction. The barge platform was maneuvered into position by the tugboat Betty L of Westar Marine Services.

2.1.1 Navigation

Navigational services were provided by Land and Sea Surveyors of Ventura, California, using a Miniranger transceiver/receiver system. Five shore control sites were used to assure horizontal accuracy (±2m). The ranges to each of the planned sampling sites were entered into a computer system set up on the tugboat, which generated a plot of each point on a monitor in the wheelhouse. The skipper of the tugboat would maneuver the barge to the sampling point by watching the movement of the tug and barge on the monitor. When the winds and currents prevented efficient maneuvering by this method, the barge would be anchored so the tug could locate and mark the sampling sites with buoys. Water depths were measured from the barge deck using a handheld fathometer. Tide corrections were made using daily tide book

predictions for the closest appropriate point to the sampling site. West Richmond stations were corrected to the Chevron pier, while Pinole Shoal stations were corrected to the nearest control point of Hercules, Mare Island, or Pinole Point. If, within a 25-ft radius of any station, there were no depths shallower than -47 ft MLLW, the station was repositioned.

2.1.2 Sediment Sampling

Two types of core samplers, a 12-in diameter split core and a 4-in diameter lexan-lined push tube, both designed by Battelle, were used to meet the sediment sampling requirements for Phase II. Both samplers were deployed from D/B Hagar in a similar manner. To collect a sample, the core sampler was suspended from the crane on the derrick barge, and the crane lowered the sampler to the surface of the sediment. If the mass of the sampler itself did not penetrate the sediment to -47 ft MLLW (project depth of -45 ft MLLW plus 2 ft overdepth), the core sampler was driven to depth by a 6-ton electric vibratory hammer. The core barrel was then lifted from the sediment by the crane, decoupled from the vibratory hammer, and lowered onto the deck of the barge.

The 12-in split core sampler yield is approximately 5.8 gallons of sediment per running foot, so it was used to collect the large volumes of sediment needed for the WES uplands and wetlands testing programs. The sampler consists of a 12-in diameter pipe that is split for approximately 30 ft. This 30 ft opening is separated into two hinged door areas that are each 10 ft long. The upper door of this split core was welded shut most of the time, but was cut open when a longer core was needed. The lower door was held shut by chain binders during sampling. Sediment was retained in the 12-in split core either by the plugging the bottom of the core with compact sands or silts whose strength of compaction was sufficient to retain the core in the tube or by a specially designed flapper valve. When a 12-in core was brought on deck, the lower door was unchained and pried open to expose the sediment. The length of the core was measured and recorded. If sufficient sediment was collected, the sediment from the appropriate depth fraction (mudline to -47 ft MLLW) was shoveled into a labeled, epoxy-coated 55-gal drum. The drums were

kept covered at all times unless actively being filled. The core sampler was thoroughly rinsed with seawater between stations.

The 4-in diameter sampler was used to collect cores from the West Richmond sites for geological description and chemical analysis. The quantity of sediment provided per foot in this core is approximately 1.9 L. The 4-in core barrel was lined with a length of steam-cleaned non-contaminating Lexan polycarbonate tubing, which protected the sediment from disturbance and contamination. Sediment was retained in the Lexan core liner either by specially designed ball valves and core catchers or a flapper valve. When the sampler was brought onto the barge, the Lexan liner containing the sediment was pulled from the sampler and measured to confirm that sufficient depth was reached. The core was then capped at both ends and labeled. If necessary, samples were cut and capped in shorter sections to fit inside the storage freezer on board the D/B Hagar, where all core samples were stored at approximately 4°C.

At the end of each day of sampling, samples were loaded into a refrigerated truck maintained at approximately 4°C. When all sampling was completed, samples for WES were shipped to Vicksburg, Mississippi, in one refrigerated truck. Samples for Battelle were shipped to the MSL, Sequim, Washington, using another truck.

2.2 SEDIMENT SAMPLE PREPARATION AND GEOLOGICAL DESCRIPTIONS

After 4-in core samples arrived at MSL, they were stored in a walk-in cold room at 4°C until processed. Each core was cut in half longitudinally, and measured from the top to the -47 ft MLLW point, where it was marked. Sediment between the mudline and -47 ft MLLW was removed from one half of the core, using a clean, solvent-rinsed stainless steel spoon, and taking care to avoid removal of sediment that was in contact with the Lexan liner. Sediment was placed in a clean, solvent-rinsed stainless steel bowl, and homogenized with the spoon until consistent in color and texture. Aliquots of homogenized sediment were removed to appropriately labeled containers for analysis of metals, butyltins, organics, and grain size. Sediment sample containers were logged in to MSL's chemistry laboratory, and distributed for appropriate

analyses. The other half of the core was wrapped in sheet teflon secured with tape, labeled, and stored in the 4°C cold room until a geological description could be done. The geological descriptions were performed according to the American Society for Testing and Materials (ASTM) Procedure D2488-84, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) (ASTM 1984). This procedure is detailed in Appendix A.

2.3 ANALYTICAL CHEMISTRY

The following sections briefly describe the methods used for analysis of West Richmond sediment for the required chemical and physical parameters. A total of five sediment samples were analyzed for conventional parameters such as total organic carbon (TOC), total volatile solids (TVS), oil and grease, total petroleum hydrocarbons (TPH) and grain size These samples were also analyzed for eleven metals, butyltins, polychlorinated biphenyls (PCBs), chlorinated pesticides, and polynuclear aromatic hydrocarbons (PAHs). Analyses followed established EPA procedures where applicable. References are given for those methods not provided by EPA.

Analyses were performed at different laboratories. TVS, metals and butyltins were analyzed at MSL. TOC was performed at Global Geochemistry in Canoga Park, California. PCBs, pesticides, PAHs, oil and grease and TPH were analyzed at Twin City Testing, St. Paul, Minnesota. Grain size analyses were performed at Soil Technologies, Bainbridge Island, Washington.

Table 2.1 presents a list of the analytes and their detection limit goals. Quality control samples included a set of analytical triplicates, matrix spike and matrix spike duplicate analyses, surrogates and method blanks.

TABLE 2.1. Analytical Chemistry Requirements for John F. Baldwin Ship Channel Sediment Samples

PARAMETERS	DETECTION LIMITS [(a)] (mg/kg)
Conventionals	
Total Organic Carbon	0.1%
Total Oil and Grease	20
Total Petroleum HCs	20
Total Volatile Solids	0.1%
Grain Size	N/A
Metals	
Ag	0.1
As	2
Cd	0.1
Cr	2
Cu	2
Hg	0.02
Ni	2
Pb	2
Se	1
Tl	10.1
Zn	2
Organics	
Butyltins	0.01
PCBs [(b)]	0.02
PAHs [(c)]	0.02
Pesticides [(d)]	0.002

(a) Target detection limits; all efforts were made to reach lowest practical detection limits.
(b) Reported as aroclor equivalents 1242, 1248, 1254, and 1260 and total PCB.
(c) All compounds on EPA method 610 list.
(d) All compounds on EPA Method 608 list.

2.3.1 Sediment Conventionals

Grain Size

Grain size of sediment samples was determined by a combination of sieve and pipet techniques following the Puget Sound Estuary Program (PSEP) Protocols for Measuring Selected Environmental Variables in Puget Sound (PSEP 1986). These methods are consistent with ASTM D421 (ASTM 1978) and D422 (ASTM 1972). Approximately 25 g of sediment was removed for analysis of total solids while another 10- to 100-g aliquot was weighed for grain size analysis. To separate the coarser sand and gravel fraction from the silt/clay fraction, sediment was washed with distilled water through a 63.5-μm (4.0 phi) sieve into a 1-L graduated cylinder. The coarse fraction was dried, weighed and shaken through a nest of sieves to yield the required seven coarse subfractions. Any material still passing the final 63.5-um sieve was added to the previous fines in the 1-L graduated cylinder. The silt/clay fraction was then subdivided by a pipet technique based on Stoke's Law of differential settling velocities for different sized particles. The silt/clay fraction was disassociated by a dispersant in distilled water in a 1-L graduated cylinder. At specified time intervals and specified depths below the surface, 20-mL aliquots of suspension were withdrawn from the graduated cylinder, delivered to a preweighed container, and dried to constant weight at 90±2°C. Quality control measures included triplicate analysis of one sample. Spikes, standard reference materials, or minimum detection limits do not apply to grain size.

Total Organic Carbon

The TOC measurement includes the amount of non-volatile, partially volatile, volatile and particulate organic compounds in a sample. The TOC in sediment was determined by measuring the carbon dioxide released during combustion of the sample (PSEP 1986; SW846 Method 9060, EPA 1986). The sediment sample was dried and ball milled. Before combustion, inorganic carbonate was removed by acidification. Total organic carbon (TOC) was analyzed by combusting samples at 800°C and using a DC-80 Total Carbon Analyzer with a Sludge and Sediment Sampler accessory. Quality control measures included a matrix spike and triplicate analysis of one sample. Results are reported as percent of dry weight.

Total Volatile Solids

TVS is a measure of the fraction of total solids that are lost on ignition at a higher temperature than that used to determine total solids. Total volatile solids is used as an estimate of the amount of organic matter in the total solids. TVS is operationally defined by the combustion temperature. TVS does not always represent the organic content of a sample because some organic material may be lost at the drying temperature and some inorganic material may be lost at the ignition temperature.

The method used to determine TVS in John F. Baldwin Ship Channel sediments followed that defined in the Puget Sound Protocols (PSEP 1986). The sample was dried to constant weight by freeze-drying and ball milled to a fine powder. A portion was removed, weighed, and combusted at 550°C. The sample was cooled in a desiccator and then reweighed. The amount of sample lost during ignition was defined as the volatile fraction and expressed as a percent of the dry weight of the total solids.

Oil and Grease and Petroleum Hydrocarbons

Total oil and grease includes vegetable oils, animal fats, soaps, waxes and any other carbon-hydrogen material extractable by the solvent Freon. Total petroleum hydrocarbons are the mineral fraction of total oil and grease. Infra-red spectrophotometry (IR) is used to determine concentrations of oil and grease (Method 413.2, EPA 1979) and petroleum hydrocarbons (Method 418.1, EPA 1979). A 20-g aliquot of sample was dried with anhydrous sodium sulfate, then extracted with Freon.

For total oil and grease, sample extracts were scanned from 4000 to 600 cm^{-1} on an infrared spectrophotometer and the peak height measured at $2930 cm^{-1}$. Oil and grease and total petroleum hydrocarbons (TPH) were extracted from sediment with freon, diluted, and split into two aliquots. The TPH aliquot was treated with silica gel to remove non-petroleum oils. Each aliquot was analyzed using an IBM IR/42 infrared spectrometer. This wavelength represents the $-CH_2$ configurations of hydrocarbons and was the standard used to determine oil and grease.

For total petroleum hydrocarbons, silica gel was added to the extract to remove the animal and vegetable based oils. The extract was then shaken and allowed to settle, and an aliquot was removed and scanned the same way as for oil and grease. The relationship of peak height to oil concentration was determined by regressing the peak height versus a known concentration of fuel oil.

2.3.2 Metals

Eleven metals were measured in John F. Baldwin Ship Channel sediments: silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), thallium (Tl), and zinc (Zn). Six of these metals (As, Cr, Cu, Ni, Pb and Zn) were measured by energy-diffusive X-Ray fluorescence (XRF) following the method of Nielson and Sanders (1983). Mercury was analyzed by cold-vapor atomic absorption spectroscopy (CVAA) (SW846 Method 7471, EPA 1986a; Bloom and Crecelius 1983), while Ag, Cd, Se and Tl were analyzed by Zeeman graphite-furnace atomic absorption spectroscopy (GFAA) (SW846 7000 series, EPA 1986a; Bloom and Crecelius 1984).

To prepare sediments for analysis, samples were freeze-dried, then blended in a Spex mixer-mill. Approximately 5 g of mixed sediment was ground in a ceramic ball mill. The XRF analysis was performed on a 0.5-g aliquot of dried, ground sediment pressed into a pellet of 2 cm diameter. For GFAA and CVAA analysis, 0.2-g aliquots of dried homogenate went through an acid digestion process to separate and isolate the metals from the sediment. Quality control measures for metals determination included analysis of blanks (not applicable to XRF technique), one set of triplicate analyses and analysis of two SRM samples: National Bureau of Standards (NBS) SRM 1646 and National Research Council of Canada (NRCC) SRM MESS-1.

2.3.3 Butyltins

Butyltin compounds were analyzed using gas chromatography with flame photometric detection (GC-FPD) following the methods of Unger et al. (1986). Approximately 10 g of wet sediment was weighed into a solvent-rinsed jar, dried with anhydrous sodium sulfate, then extracted from sediment with 110 mL methylene chloride ($MeCl_2$) and 0.25 g tropolone. Propyltin was added before

extraction as a surrogate compound to assess extraction efficiency. The extract was decanted through silanized glass wool to remove particles, and the container rinsed three times with $MeCl_2$ to ensure that all extracted material was recovered. The mono-, di-, and tributyltin compounds extracted from the sediment were derivatized with n-hexyl magnesium bromide to a less volatile, more thermally stable (nonionic n-hexyl derivatives).

The extracts were passed through a fluoracil liquid chromatography column for cleanup and the butyltins quantified by GC-FPD. Concentrations were reported in µg/kg dry weight of mono-, di-, and tributyltin species as tin. Total butyltins were calculated by adding the concentrations of detected species (as opposed to a measured total). The recently certified NRCC SRM PACS-1 for butyltins was analyzed along with John F. Baldwin Ship Channel sediments.

2.3.4 Semivolatile Organic Compounds

The semivolatile organic compounds analyzed in John F. Baldwin Ship Channel sediments were the 16 polynuclear aromatic hydrocarbons (PAHs) listed in EPA Method 610. These compounds were extracted from sediments and analyzed by gas chromatography/ mass spectroscopy in the Selective Ion Mode (GC/MS SIM), a modification of EPA SW846 Method 8270. Surrogate compounds (Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, and Benzo(a)pyrene-d12) were added to each sample to assess extraction efficiency. Matrix spiking solutions and matrix spike duplicate measurements were made to assess accuracy of measurement. A standard reference material, SRM HS-4, was analyzed in duplicate. A method blank was analyzed to detect potential contamination.

2.3.5 Chlorinated pesticides and Polychlorinated Biphenyls (PCBs)

Chlorinated pesticides and PCBs in sediments were quantified by Gas Chromatography/Electron Capture Detection (GC/ECD) following EPA SW846 Method 8080 (EPA 1986a). Chlorinated pesticides and PCBs were extracted overnight using $MeCl_2$ with solvent exchange to hexane for GC/ECD analysis. Dibutylchlorendate (DBC) was the surrogate compound added to each sample before extraction to assess extraction efficiency. The matrix spiking solution was also added to the appropriate samples before extraction. Matrix

spike and matrix spike duplicate analyses were conducted to assess accuracy of measurement. One sample was analyzed in triplicate to assess analytical precision. A method blank was also analyzed.

3.0 RESULTS

Sampling for the John F. Baldwin Ship Channel Phase II program was accomplished in mid-August, 1990. At that time, samples for wetlands and uplands testing were shipped directly to WES, and samples for chemistry and geology from the new West Richmond stations were shipped to MSL. This section describes the results of field sampling for both WES and MSL, and the results of chemical and geological analysis of the West Richmond core samples.

3.1 SEDIMENT SAMPLING FOR BATTELLE MSL ANALYSIS OF WEST RICHMOND CORES

One core sample was collected from each of five new sites in the West Richmond reach of John F. Baldwin Ship Channel. All sampling was conducted on August 14, 1990, using the 4-in core sampler as described in Section 2.1.2. The new sampling sites (WR-A, WR-B, WR-C, WR-D, and WR-E) are shown on Figure 3.1, which also shows the Phase I stations for comparison. Complete sampling information is provided in Table 3.1. All sampling sites were shallower than -47 ft MLLW, so relocation of stations to shallower areas was not necessary.

TABLE 3.1. Sampling Information for Phase II West Richmond Stations (4-in cores in Lexan tubes for geology and chemistry)

STATION	REP	CALIFORNIA ZONE III STATE PLANE COORDINATES Y (Northing)	X (Easting)	DATE SAMPLED	WATER DEPTH (ft MLLW)	CORE REQUIRED (ft to -47 ft MLLW)	CORE COLLECTED (ft)	COMMENTS
WR-A	1	523,268	1,439,718	08-14-90	36.8	10.2	14	
WR-B	1	521,019	1,440,107	08-14-90	34.8	12.2	17	
WR-C	1	518,602	1,440,857	08-14-90	34.5	12.5	18.5	3 attempts
WR-D	1	518,308	1,439,457	08-14-90	42.4	4.6	6.5	
WR-E	1	517,380	1,439,924	08-14-90	40.9	6.1	6.5	

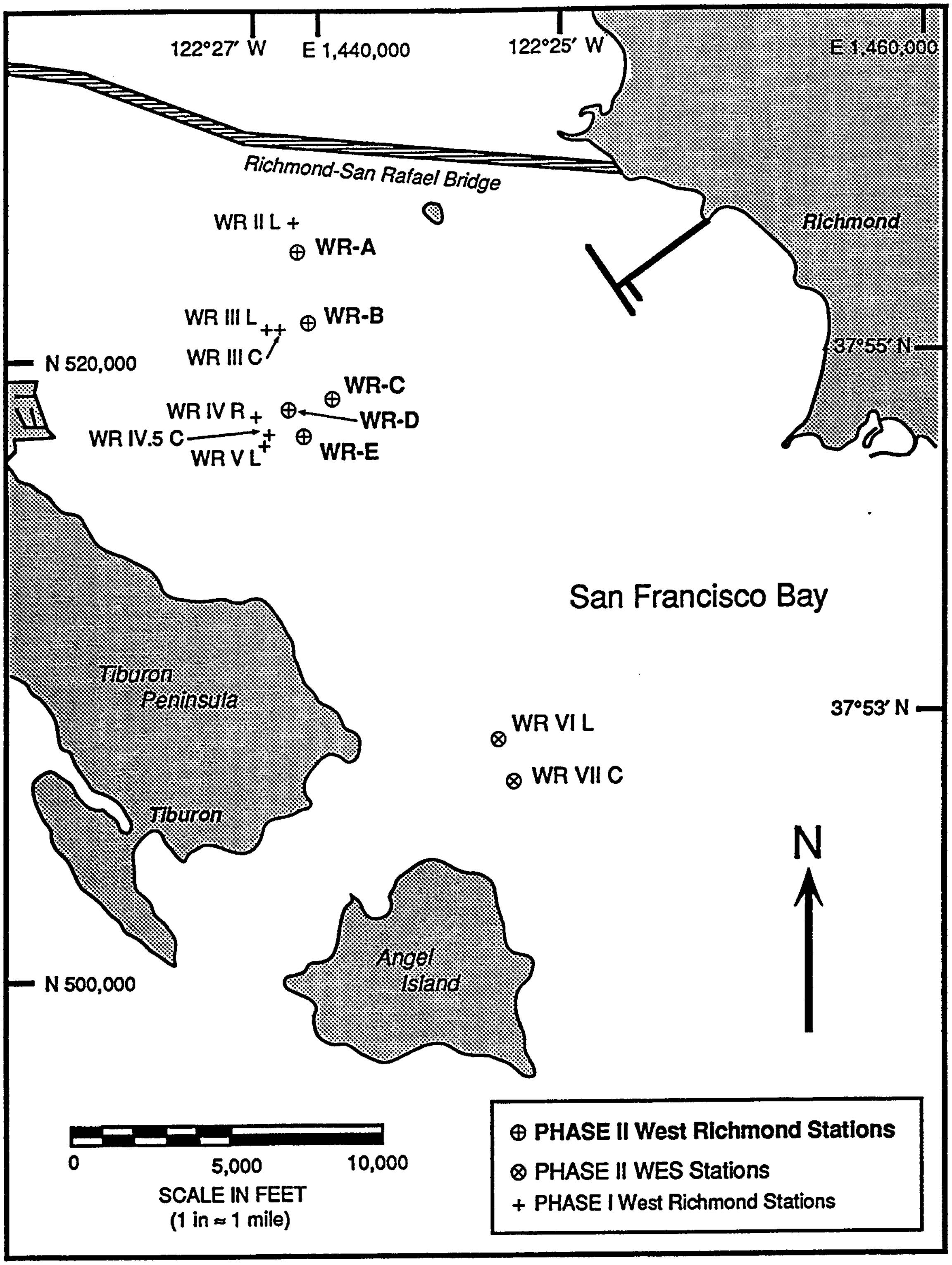

FIGURE 3.1. West Richmond Sampling Sites, John F. Baldwin Ship Channel, Showing Both Phase I and Phase II Stations

3.2

3.2 SEDIMENT SAMPLING FOR WES WETLANDS/UPLANDS TESTING

Sediments from stations in both West Richmond and Pinole Shoal reaches of John F. Baldwin Ship Channel were collected for the WES Uplands testing program, while only Pinole Shoal stations were sampled for the Wetlands testing program. Sampling was conducted August 13, 15, and 16, 1990, using the 12-in core sampler as described in Section 2.1.2. Sampling stations are shown in Figures 3.1 and 3.2. One station, P I C, had to be relocated to the northwest edge of the channel because the original site was already at project depth (-45 ft MLLW).

Sediments from multiple stations were added together to form Uplands Composite 1 (southern part of West Richmond reach), Wetlands Composite 2 (southwest Pinole Shoal), Wetlands Composite 3 (east Pinole Shoal), and Uplands Composite 4 (all Phase II Pinole Shoal stations). Fourteen 55-gal drums were needed for each uplands composite, while each wetlands composite required one 55-gal drum to be filled. To obtain the required volume of sediment, it was often necessary to collect replicate samples at some stations. The stations contributing to each composite, and the volume contributed, are listed in Table 3.2 along with other pertinent sampling information.

To accompany sediment for the WES Uplands testing program, 20 gallons of water were obtained from the West Richmond and Pinole Shoal sampling areas. Surface water samples were collected using a clean 5-gal bucket to fill a labeled, epoxy-coated 30-gal barrel. West Richmond site water was collected between Stations WR VI L and WR VII C on August 13. Pinole Shoal site water was collected near Station P IV R on August 16. Both sediment and water samples were shipped via refrigerated truck from Vallejo, California, to Vicksburg, Mississippi, on August 17, 1990.

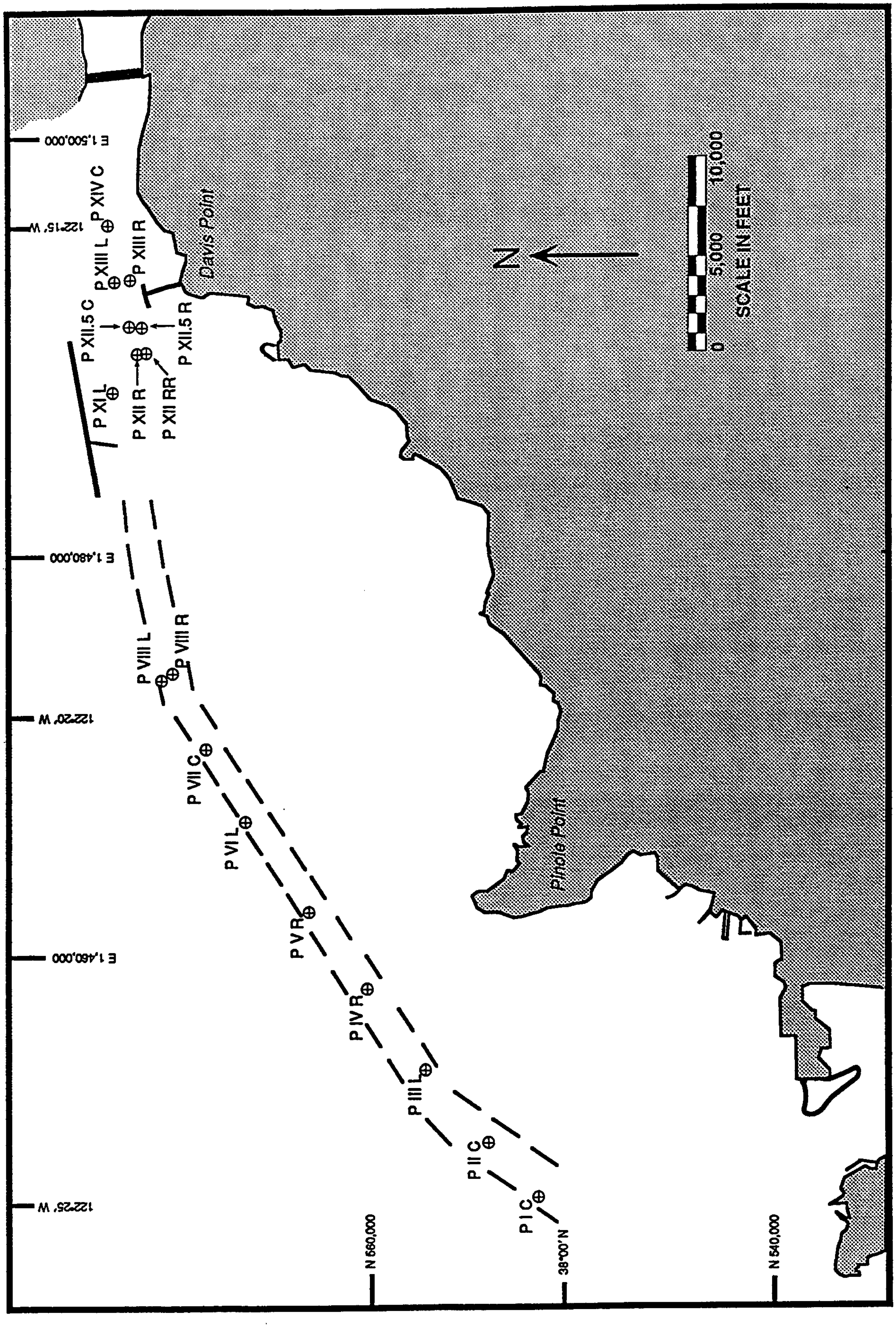

FIGURE 3.2. Pinole Shoal Sampling Sites, John F. Baldwin Ship Channel Phase II

TABLE 3.2. West Richmond and Pinole Shoal Stations Sampled for WES Uplands and Wetlands Testing (using 12-in core sampler)

STATION	REP	CALIFORNIA ZONE III STATE PLANE COORDINATES Y (Northing)	X (Easting)	DATE SAMPLED	WATER DEPTH (ft MLLW)	REQUIRED (ft to -47 ft MLLW)	CORE COLLECTED (ft)
West Richmond: Uplands Composite 1 (385 gallons per station)							
WR VII C	1	506,474	1,446,662	08-13-90	39.8	7.2	6.7
WR VII C	2	506,474	1,446,662	08-13-90	39.8	7.2	6.7
WR VII C	3	506,474	1,446,662	08-13-90	39.8	7.2	7.0
WR VII C	4	506,474	1,446,662	08-13-90	39.8	7.2	8.0
WR VII C	5	506,474	1,446,662	08-13-90	39.8	7.2	8.5
WR VII C	6	506,474	1,446,662	08-13-90	39.8	7.2	8.0
WR VII C	7	506,474	1,446,662	08-13-90	39.8	7.2	7.8
WR VII C	8	506,474	1,446,662	08-13-90	39.8	7.2	7.5
WR VII C	9	506,474	1,446,662	08-13-90	39.8	7.2	7.5
WR VII C	10	506,474	1,446,662	08-13-90	39.8	7.2	7.8
WR VI L	1	507,711	1,446,074	08-13-90	39.7	7.3	7.0
WR VI L	2	507,711	1,446,074	08-13-90	39.7	7.3	6.8
WR VI L	3	507,711	1,446,074	08-13-90	39.7	7.3	7.5
WR VI L	4	507,711	1,446,074	08-13-90	39.7	7.3	8.0
WR VI L	5	507,711	1,446,074	08-13-90	39.7	7.3	8.0
WR VI L	6	507,711	1,446,074	08-13-90	39.7	7.3	7.8
WR VI L	7	507,711	1,446,074	08-13-90	39.7	7.3	7.5
WR VI L	8	507,711	1,446,074	08-13-90	39.7	7.3	8.0
WR VI L	9	507,711	1,446,074	08-13-90	39.7	7.3	7.5
WR VI L	10	507,711	1,446,074	08-13-90	39.7	7.3	7.8
WR VI L	11	507,711	1,446,074	08-13-90	39.7	7.3	8.0
Pinole Shoal: Wetlands Composite 2 (6 gallons per station) and Uplands Composite 4 (43 gallons per station)							
P VIII R	1	569,815	1,473,806	08-15-90	36.2	10.8	14.0
P VIII L	1	570,269	1,473,536	08-15-90	37.2	9.8	9.8
P VII C	1	568,126	1,470,212	08-15-90	36.0	11.0	11.0
P VI L	1	566,221	1,466,553	08-16-90	36.6	10.4	11.3
P V R	1	563,067	1,462,079	08-16-90	37.1	9.9	13.6
P IV R	1	560,133	1,458,245	08-16-90	40.3	6.7	12.0
P IV R	2	560,133	1,458,245	08-16-90	40.3	6.7	9.5
P III L	1	557,301	1,454,275	08-16-90	42.8	4.2	5.7
P III L	2	557,301	1,454,275	08-16-90	42.8	4.2	6.0
P II C	1	554,046	1,450,790	08-16-90	41.8	5.2	6.8
P II C	2	554,046	1,450,790	08-16-90	41.8	5.2	8.5
P I C	N/A	551,186	1,448,210	08-16-90	44.8	N/A	N/A
P I C	1	551,713	1,448,049	08-16-90	43.8	3.2	4.5
P I C	2	551,713	1,448,049	08-16-90	43.8	3.2	6.0
P I C	3	551,713	1,448,049	08-16-90	43.8	3.2	4.5

3.5

TABLE 3.2. (Continued)

STATION	REP	CALIFORNIA ZONE III STATE PLANE COORDINATES Y (Northing)	X (Easting)	DATE SAMPLED	WATER DEPTH (ft MLLW)	REQUIRED (ft to -47 ft MLLW)	CORE COLLECTED (ft)
Pinole Shoal: Wetlands Composite 3 (7 gallons per station) and Uplands Composite 4 (48 gallons per station)							
P XIV C	1	573,019	1,495,878	08-15-90	40.8	6.2	7.0
P XIV C	2	573,019	1,495,878	08-15-90	40.8	6.2	7.3
P XIII R	1	571,966	1,493,161	08-15-90	37.7	9.3	9.8
P XIII L	1	572,705	1,493,026	08-15-90	44.4	2.6	2.6
P XIII L	2	572,705	1,493,026	08-15-90	44.4	2.6	7.0
P XIII L	3	572,705	1,493,026	08-15-90	44.4	2.6	5.0
P XIII L	4	572,705	1,493,026	08-15-90	44.4	2.6	5.0
P XIII L	5	572,705	1,493,026	08-15-90	44.4	2.6	5.0
P XII.5 C	1	571,871	1,490,811	08-15-90	41.9	5.1	7.6
P XII.5 C	2	571,871	1,490,811	08-15-90	41.9	5.1	7.0
P XII.5 R	1	571,343	1,490,800	08-15-90	31.3	15.7	17.5
P XII R	1	571,422	1,489,561	08-15-90	38.9	8.1	9.5
P XII R	2	571,422	1,489,561	08-15-90	38.9	8.1	8.3
P XII RR	1	571,160	1,489,564	08-16-90	38.8	8.2	8.5
P XII RR	2	571,160	1,489,564	08-16-90	38.8	8.2	10.2
P XI L	1	572,673	1,487,592	08-15-90	43.6	3.4	4.5
P XI L	2	572,673	1,487,592	08-15-90	43.6	3.4	4.5
P XI L	3	572,673	1,487,592	08-15-90	43.6	3.4	6.3

3.6

3.3 ANALYSIS OF PHASE II WEST RICHMOND CORES

Following delivery to MSL, the 4-in cores from the new West Richmond stations were cut, homogenized, and subsampled for chemistry as described in Section 2.2. Initial core cutting and sample preparation occurred on August 21, 1990, and chemistry samples were shipped immediately to the analytical laboratory. The core halves for geological description were stored in the walk-in cold room at MSL until September when a geologist was available to perform the descriptions. A summary of the geological descriptions and the results of chemical analysis are presented in the following sections.

3.3.1 Geological Description

Geology of John F. Baldwin Ship Channel

In this section, the general geology of the John F. Baldwin Ship Channel sediments is described, followed by descriptions of the 5 new core samples collected in August 1990. Three geologic units are present in the John F. Baldwin Ship Channel study area: the Older Bay Mud, Sand Deposits, and Younger Bay Mud (USACE, 1975a). The oldest unit is the Older Bay Mud which consists primarily of firm clay, silt, sand, and small gravels deposited during the last glacial period when sea level resided as much as 335 ft below its present level (USACE, 1975b, 1979). None of the cores collected during the most recent phase of coring penetrated to this Older Bay Mud unit, therefore, no further discussion is presented here.

The Sand Deposits form a unit that lies between the underlying Older Bay Mud and the overlying Younger Bay Mud; thickness of the Sand Deposits is not uniform throughout, being generally thicker along bay margins. The Sand Deposits are fine grained and mixed with considerable silt and clay; the unit is believed to represent alluvial fans formed by fluviatile current action during shoreline fluctuation in the Pleistocene (USACE, 1975a). Although considerable amounts of fine sands are present in several cores, it is unlikely that they represent the Sand Deposit unit due to the shallow depths penetrated during core sampling.

The Younger Bay Mud (YBM) consists of mostly soft, dark- colored sediments deposited in an estuarine environment. These deposits were laid

down as sea level rose following the last ice age, which ended approximately 12,000 years ago (Barry, 1983). The YBM unit appears to form a continuous blanket across the bay bottom. The YBM unit consists mostly of very soft to soft silty clays and clayey silts with minor amounts of organic material, fine sand and shell fragments (USACE, 1975a). Soil colors range from dark gray to dark olive gray to black. Dark colors, in combination with the odor of rotten eggs (i.e., hydrogen sulfide), are indications of chemically reducing conditions. The USACE (1975a) subdivided the YBM unit into a Semi-Consolidated Bay Mud member overlain by Soft Bay Mud member. While the firmness of the cores from the study areas generally increases with depth, this appears to be a result of compaction from overlying sediments rather than the sudden, characteristic change in consistency which is considered the boundary between the Semi-Consolidated Bay Mud and Soft Bay Mud members (USACE, 1979). The shallow nature of the sediment cores would suggest that the primary unit represented in the sampling areas is the Soft Bay Mud member of the Younger Bay Mud.

Phase II West Richmond Cores

A total of five cores, ranging in length from 4.7 to 12.8 ft, were characterized from the West Richmond reach of the John F. Baldwin Ship Channel. Detailed methods for the description of core logs are contained in Appendix A. A descriptive data log for each of the Phase II cores is contained in Appendix B. Only the YBM unit was represented in these cores.

Figure 3.3 shows a cross section along the northern portion of the West Richmond reach and includes the Phase I (September 1989) cores WR I R, WR II L, WR III L, WR IV R, WR IV.5 C, and WR V L as well as the Phase II cores WR-A, WR-B, WR-C, WR-D, and WR-E. The cores sampled in September 1990 consist predominantly of dark olive gray to very dark olive gray sands with alternating layers of interstratified silt and/or clay. Most sediments entering the bay system were probably deposited during periods of high runoff and turbulence associated with winter storms. These storm deposits produced normally graded beds ranging from millimeters to several centimeters in thickness, depending on distance from the source and the amount of sediment in suspension.

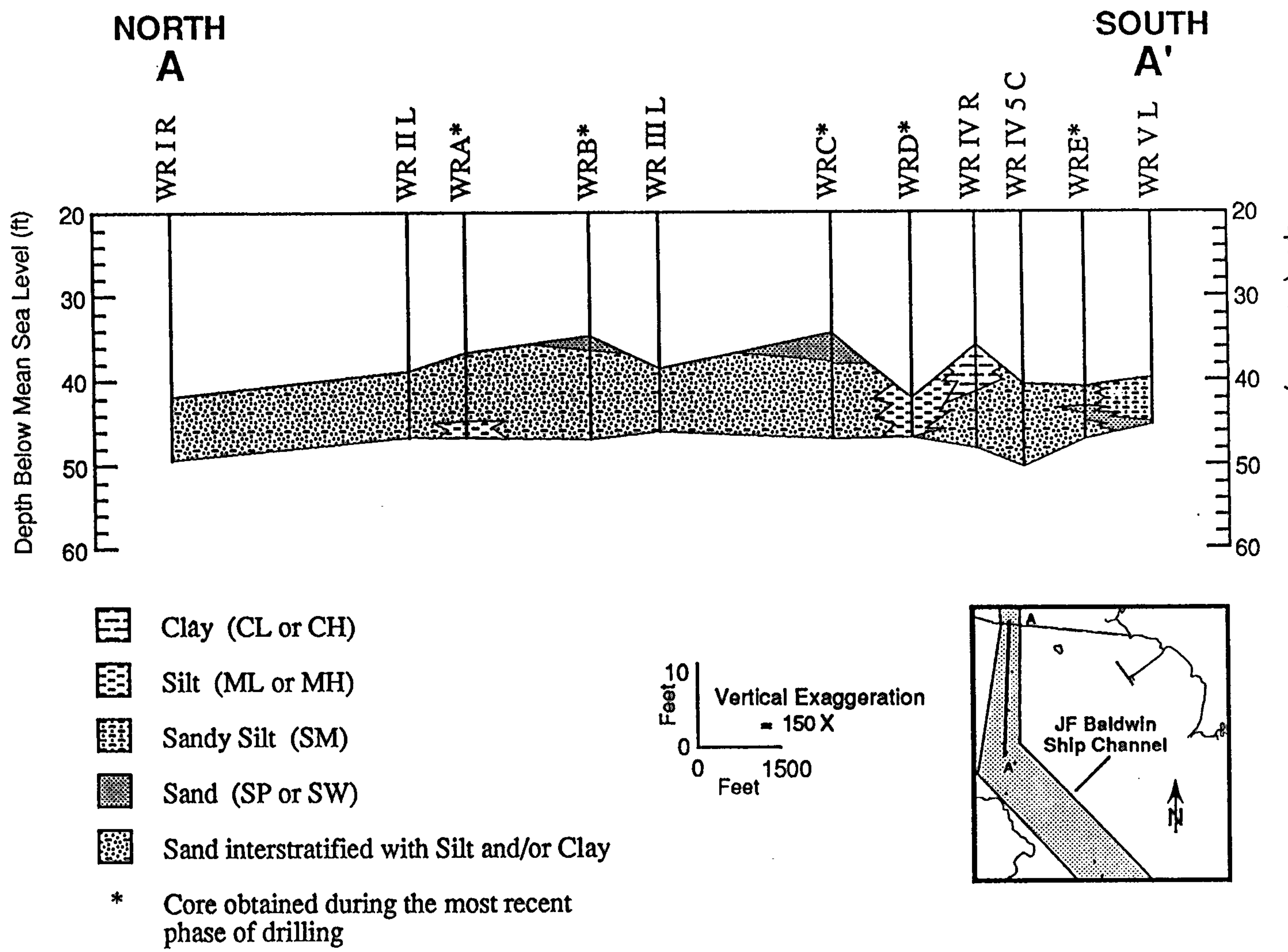

FIGURE 3.3. Sediment Lithology in the West Richmond Reach of John F. Baldwin Ship Channel

The maximum particle size was very fine pebbles found interspersed in cores WR-C and WR-D. All cores had considerable amounts of finer material such as sand interstratifed with silt and clay. Of the new cores, core WR-D, contained the greatest percentage of fines. Fine-grained sediments with relatively little sand appear to be concentrated in a small area between stations WR-C and WR IV R. Coarser-grained sand locally lies along the highest elevation (shallowest) portions of the channel (e.g. WR-B and WR-C).

All West Richmond cores contained varying amounts of shell fragments and one core from station WR-A contained wood fragments at 0.5 ft and 10 ft below the mudline. The wood fragments, of terrestrial origin, were probably deposited during storms. Colors of the West Richmond sediments ranged from olive gray to dark olive gray to black, typical of the YBM unit, with no overall trends throughout the sample area. The dark sediment colors suggest chemically reducing conditions that may be in part due to storage time prior to characterizing the geology of the cores.

3.3.2 Analytical Chemistry

Grain Size

Grain size in the West Richmond core samples was analyzed by a combination of sieve and pipet methods to separate 16 sediment size-classes. To assess accuracy of grain size analysis, WR-E was analyzed in triplicate. Results (Tables 3.3 and 3.4) show no more than 1% (weight/weight) difference between replicates in any size class. Table 3.3 summarizes grain size analysis of the West Richmond core samples (mudline to -47 ft MLLW) as percent gravel, sand, silt, and clay. For finer distinctions between grain size classes, refer to Table 3.4.

Grain size analysis of the Phase II West Richmond cores shows that sediments are mostly sand, with small amounts of fine material. This is consistent with the geological description of the West Richmond cores as consisting of sands with alternating layers of interstratified silt and clay.

TABLE 3.3. Summary of Grain Size Analysis, Phase II West Richmond Cores

Station	Percent Gravel (≥2000 um)	Percent Sand (62.5-2000 um)	Percent Silt (3.9-62.5 um)	Percent Clay (≤3.9 um)
WR-A	4	67	16	13
WR-B	3	64	18	15
WR-C	5	72	12	11
WR-D	3	55	23	19
WR-E(a)	2	72	14	12
Triplicate analysis				
WR-E rep 1	2	72	14	12
WR-E rep 2	1	73	14	12
WR-E rep 3	2	72	14	12

(a) Mean of three replicates

TABLE 3.4. Results of Grain Size Analysis, Phase II West Richmond Cores

	Percent at Size Fraction																
	Gravel		Sand						Silt				Clay				
phi	-2.25	-1	-0.25	1.25	2	3.25	3.75	4	5	6	7	8	9	10	11	12	
STATION µm	>4750	4750-2000	2000-850	850-425	425-250	250-106	106-75	75-62.5	62.5-31.2	31.2-15.6	15.6-7.8	7.8-3.9	3.9-1.9	1.9-0.9	0.9-0.4	0.4-0.2	<0.2
WR-A	1	3	4	4	15	40	2	2	4	6	4	2	2	3	2	6	0
WR-B	2	1	4	5	16	36	2	1	5	7	4	2	3	4	1	7	0
WR-C	1	4	8	7	25	30	1	1	2	5	3	2	2	2	2	5	0
WR-C	1	4	7	8	35	29	1	0	2	6	2	3	2	1	2	5	0
WR-D	0	3	7	7	14	25	2	0	7	7	5	4	2	4	3	8	2
WR-E Rep 1	0	1	3	5	19	43	2	1	4	4	4	2	2	2	2	5	1
Analytical Replicate Analyses																	
WR-C Rep 1	1	4	8	7	25	30	1	1	2	5	3	2	2	2	2	5	0
WR-C Rep 2	1	4	7	8	35	29	1	0	2	6	2	3	2	1	2	5	0
I-stat	0.00	0.00	0.07	0.07	0.17	0.02	0.00	1.00	0.00	0.09	0.20	0.20	0.00	0.33	0.00	0.00	0
RPD (%)	0	0	13	13	53	3	0	2	0	18	40	40	0	67	0	0	0
WR-E Rep 1	0	1	3	5	19	43	2	1	4	4	4	2	2	2	2	5	1
WR-E Rep 2	1	1	2	6	18	43	2	1	4	5	3	2	2	3	1	6	0
I-stat	1.00	0.00	0.20	0.09	0.03	0.00	0.00	0.00	0.00	0.11	0.14	0.00	0.00	0.20	0.33	0.09	1.00
RPD (%)	2	0	40	18	5	0	0	0	0	22	29	0	0	40	67	18	2

Total Volatile Solids (TVS), Total Organic Carbon (TOC), Oil and Grease, and Total Petroleum Hydrocarbons (TPH)

Quality control results (Table 3.5) showed that detection limits were met for each of the conventional parameters TVS, TOC, oil and grease, and TPH. Acceptable comparisons occurred between replicates in the triplicate analyses of WR-C (TOC) and WR-E (TVS, oil and grease, TPH). Coefficients of variation (CV) for the measurements ranged from 8.2 to 11.5 for TOC, TVS, and TPH replicate measurements. The most variable measurement was oil and grease, with a CV of 35.6%.

A matrix spike (MS) and a matrix spike duplicate (MSD) were analyzed for TOC with measured recoveries of 113 and 96%. Matrix spikes and matrix spike duplicates were not performed for volatile solids because they are inappropriate for that parameter. Recoveries for the TPH MS and MSD were 13% and 56% respectively. The low recovery of one of the TPH spikes was attributed to loss of solvent during the extraction procedure, the other spike had acceptable recovery. Recoveries of the MS and MSD for oil and grease were 42% and 107%, respectively, which were acceptable. No analytes were detected in either the TPH or oil and grease method blanks. The concentrations of these conventional measures in the West Richmond samples were low.

Metals

Eleven metals were analyzed in each of the five West Richmond core sediments, following the methods described in Section 2.3.2. Quality control measures (Table 3.6) included triplicate analysis of one sample to assess analytical precision, and matrix spikes and/or standard reference materials (SRMs) to assess accuracy. Target detection limits were met for all metals analyses.

Matrix spikes to assess accuracy of GFAA and CVAA analysis of Ag, Cd, Hg, Se, and Tl all showed excellent recoveries of greater than 95%. Analysis of SRMs to assess accuracy of both XRF and AA results showed that the analytes in NRCC MESS-1 (As, Cd, Cr, Cu, Ni, Pb, Se, and Zn) were found within the certified range of the SRM except for Ni. Ni exceeded the certified reference value by approximatley 2%. The analytes in SRM NBS-1646 (As, Cd, Cr, Cu, Hg, Ni, Pb, and Zn) were within certified values except for As, Cr, and Hg.

TABLE 3.5. Total Volatile Solids (TVS), Total Organic Carbon (TOC), Oil and Grease, Total Petroleum Hydrocarbons (TPH), and Petroleum Fraction as a Percentage of Oil and Grease in West Richmond Sediment (U=undetected above given detection limit; N/A=not applicable)

SAMPLE	TVS (% dry wt)	TOC (% dry wt)	Oil and Grease (µg/kg dry wt)	TPH (µg/kg dry wt)	Petroleum Fraction
Method Blank	N/A	N/A	0.7 U	0.7 U	N/A
WR-A	5.11	0.53	17.0	14.0	82%
WR-B	5.58	0.62	8.8	9.9	100%
WR-C	5.43	1.17 (a)	4.3	0.7 U	< 16%
WR-D	6.29	0.86	18.0	1.7	9.4%
WR-E	4.79 (b)	0.71	17.2 (c)	4.3 (d)	25%
Triplicate Analysis					
WR-C Rep 1	N/A	1.12	N/A	N/A	N/A
WR-C Rep 2	N/A	1.30	N/A	N/A	N/A
WR-C Rep 3	N/A	1.10	N/A	N/A	N/A
WR-E Rep 1	5.17	N/A	24.0	0.7 U	< 3%
WR-E Rep 2	4.81	N/A	15.3	3.9	25%
WR-E Rep 3	4.39	N/A	12.2	4.6	38%
Matrix Spike		WR-C	WR-D	WR-D ?	
Amount Spiked	N/A	1.10	55.7	56.0	N/A
Amount Recovered	N/A	2.36	41.2	9.2	N/A
Amount in Sample	N/A	1.12	18.0	1.7	N/A
Percent Recovery	N/A	113%	42%	13%	N/A
Matrix Spike Duplicate		WR-C	WR-D	WR-D ?	
Amount Spiked	N/A	1.00	60.1	60.0	N/A
Amount Recovered	N/A	2.08	82.2	35.0	N/A
Amount in Sample	N/A	1.12	18.0	1.7	N/A
Percent Recovery	N/A	96%	107%	56%	N/A

(a) Mean of three replicates, sd=0.11
(b) Mean of three replicates, sd=0.39
(c) Mean of three replicates, sd=6.1
(d) Mean of two replicates where TPH detected, sd=0.49, RPD=16%

TABLE 3.6. Quality Control Data for Metals Analysis, West Richmond Sediment, John F. Baldwin Ship Channel Phase II

SAMPLE	METAL CONCENTRATION (mg/kg dry weight) Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Tl	Zn
Triplicate Analysis											
WR-E	0.055	11.2	0.12	217.0	20.6	0.047	86.9	6.2	0.15	< 0.12	64.5
WR-E	0.055	10.2	0.11	184.0	18.3	0.027	80.8	6.6	0.15	< 0.12	66.5
WR-E	0.051	9.8	0.11	196.0	19.9	0.027	82.3	9.1	0.15	< 0.12	65.4
Standard Deviation	0.002	0.7	0.006	16.7	1.2	0.012	3.2	1.6	0.00	N/A	1.0
Coefficient of Variation (%)	4.3	6.9	5.1	8.4	6.0	34	3.8	21.5	0.0	N/A	1.5
Matrix Spike (WR-D)											
Amount Recovered	0.542	N/A	1.11	N/A	N/A	0.526	N/A	N/A	1.31	2.91	N/A
Amount in Sample	0.058	N/A	0.16	N/A	N/A	0.031	N/A	N/A	0.27	< 0.12	N/A
Amount Spiked	0.500	N/A	1.00	N/A	N/A	0.500	N/A	N/A	1.00		N/A
Recovery	97%	N/A	95%	N/A	N/A	99%	N/A	N/A	104%		N/A
Standard Reference Materials											
NRCC MESS-1	N/A	10.3	0.59	80.0	24.0	N/A	33.0	34.0	0.39	N/A	183.4
Certified Value of MESS-1	NC	10.6 ± 1.2	0.59 ± 0.01	71.0 ± 11	25.1 ± 3.8	NC	29.5 ± 2.7	34.0 ± 6.1	0.34 ± 0.06	NC	191 ± 17
NBS-1646	N/A	8.9	0.32	69.0	18.2	0.077	31.8	29.9	N/A	N/A	137.5
Certified Value of NBS-1646	NC	11.6 ± 1.3	0.36 ± 0.07	76.0 ± 3	18.0 ± 3	0.063 ± 0.012	32.0 ± 3	28.2 ± 1.8	NC	NC	138 ± 6

N/A = not applicable
NC = not certified

While measured values of As and Cr were within the certified ranges for SRM MESS-1, they were slightly out of the certified range for the SRM NBS-1646. As and Cr were measured at slightly lower concentrations (13% and 5%, respectively) than the certified range of NBS-1646. Hg was measured at 3% higher than the certified range of NBS-1646.

These slight differences should not affect the accuracy of the sample measurements, given the accurate values measured for the other SRM (NRCC MESS-1) and the accurate Hg matrix spike. Triplicate analysis of WR-E showed very good precision with all coefficients of variation (standard deviation/mean) less than 10% except Hg, Cr and Pb. For each of these metals, the variation was due to one high replicate (Table 3.6). Such variation within a sample of sediment is not unusual given metal concentrations as low as those measured in West Richmond sediments.

The results of metals analysis in the five Phase II West Richmond core samples are shown in Table 3.7. All of the metal concentrations measured in the new West Richmond cores were comparable to the low end of the concentration range of West Richmond sediments sampled during Phase I of the John F. Baldwin project. In no case were there higher metals concentrations from sediments collected during Phase II.

TABLE 3.7. Metals in Phase II West Richmond Cores

SAMPLE	METAL CONCENTRATION (mg/kg dry weight) Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Tl	Zn
WR-A	0.055	7.0	0.10	196.0	20.7	0.027	76.3	8.8	0.23	< 0.12	63.6
WR-B	0.061	10.4	0.12	216.0	21.8	0.027	80.5	7.1	0.19	< 0.12	64.7
WR-C	0.055	15.0	0.13	208.0	20.2	0.033	86.3	4.1	0.27	< 0.12	62.3
WR-D	0.058	12.8	0.16	145.0	21.6	0.031	72.9	5.4	0.27	< 0.12	60.5
WR-E (a)	0.054	10.4	0.11	199.0	19.6	0.034	83.3	7.3	0.15	< 0.12	65.5

(a) Mean of three replicates, standard deviations reported beneath triplicate values in Table 3.6

Butyltins

Butyltin compounds were analyzed using gas chromatography with flame photometric detection (GC-FPD) following the methods of Unger et al. (1986), detailed in Section 2.3.3. Butyltin results and quality control data are shown in Table 3.8. Surrogate recoveries for the samples ranged from 29% to 41%. Although the majority of these recoveries fall below the control limit of 40%, the data is found to be acceptable. Recent data indicate that the surrogate compound used during analyses of these samples does not accurately reflect the behavior of the monobutyltin (MBT), dibutyltin (DBT), and tributyltin (TBT) compounds. A new surrogate is currently being used in conjunction with the propyltin and although recoveries of the original propyltin surrogate are still low, the recoveries of the new surrogate are acceptable with recoveries from 70-100%.

Matrix spike recoveries for TBT and DBT were acceptable at 55% and 68% respectively (note the propyltin surrogate recovery for the spike sample was comparable to those of the samples at 27%). Low levels of TBT and MBT (0.9 and 0.6 μg/kg respectively) were detected in the method blank. Compared to the standard reference material (SRM) measurement of accuracy, the measured values of SRM PACS showed good agreement with the certified values. It is important to note that the PACS results are corrected for the propyltin surrogate recovery. Although the surrogate used has been found to be inadequate for accurate quantitation of the butyltins, the original certification of PACS was performed by numerous laboratories using the propyltin surrogate as an internal standard, thus, the original certified values may be biased.

Butyltin compounds were found only at very low concentrations in West Richmond sediments, with less than 2 μg/kg total butyltins at all stations. These levels are comparable to or lower than the results of the John F. Baldwin Ship Channel Phase I butyltin analyses of West Richmond sediments.

TABLE 3.8. Butyltins in West Richmond Sediment (U=undetected above given detection limit; N/A=not applicable)

SAMPLE	PROPYLTIN SURROGATE RECOVERY	BUTYLTIN CONCENTRATION (µg/kg dry weight) Tri-	Di-	Mono-	TOTAL
Method Blank	19.7 %	0.9	0.6 U	0.6	1.5
WR-A	29.3 %	0.5	0.4	0.4 U	0.9
WR-B	41.8 %	0.8	0.8	0.4 U	1.6
WR-C	35.2 %	0.6	0.5 U	0.4 U	0.6
WR-D	33.7 %	0.9	0.4 U	0.4 U	0.9
WR-E Rep 1	35.9 %	0.9	0.5 U	0.6	1.5
WR-E Rep 2	36.0 %	0.8	0.5 U	0.5 U	0.8
Matrix Spike (WR-E)					
Amount Recovered	27.1 %	71.8	88.2	38.5	N/A
Amount in Sample		0.8	0.5 U	0.5 U	N/A
Amount Spiked		130	130	130	N/A
Recovery		55%	68%	30%	N/A
Standard Reference Material					
PACS[a]	39.8 %	1348	1250	445	3043
Certified Value of PACS		1270 ± 220	1160 ± 180	280 ± 170	N/A

(a) PACS certified values are corrected for surrogate recovery, therefore, PACS sample concentrations are reported corrected for the 39.8% surrogate recovery.

Polychlorinated Biphenyls (PCBs) and Pesticides

PCBs and chlorinated pesticides were extracted and analyzed according to Method 8080 in EPA Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods, SW-846 (USEPA 1986), as detailed in Section 2.3.5. For both PCBs (Table 3.9) and pesticides (Table 3.10), the achieved detection limits were acceptably low, and there were no analytes found in the method blanks. Quality control results show acceptable comparison of triplicate analyses and acceptable matrix spike/spike duplicate recoveries (Tables 3.9 and 3.11).

PCB aroclors and chlorinated pesticides were not detected in any of the samples, indicating that the West Richmond sample area is uncontaminated with respect to these compounds. This was also the case for the West Richmond samples analyzed during Phase I of the John F. Baldwin Ship Channel project. It is reasonable to expect that PCBs and pesticides would not accumulate in West Richmond sediments because of the high energy environment, lack of fine particles, and lack of organic carbon.

TABLE 3.9. Polychlorinated Biphenyls (PCBs) in West Richmond Sediment (U=undectected above given detection limit)

		PCB CONCENTRATION (µg/kg dry weight)						
SAMPLE	SURROGATE (DBC) RECOVERY	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260
Detection Limit	N/A	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Method Blank	110%	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U	20.0 U
WR-A (a)	130%	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U
WR-B	100%	28.0 U	28.0 U	28.0 U	28.0 U	28.0 U	28.0 U	28.0 U
WR-C	130%	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U
WR-D	140%	29.2 U	29.2 U	29.2 U	29.2 U	29.2 U	29.2 U	29.2 U
WR-E	140%	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U	27.2 U
WR-E	100%	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U	27.4 U
Triplicate Analysis								
WR-A Rep 1	130%	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U
WR-A Rep 2	130%	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U
WR-A Rep 3	140%	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U	27.9 U

Matrix Spike (WR-A)

Surrogate Recovery (DBC)	130%
Amount Spiked (µg/kg Aroclor 1254)	32.0
Amount Recovered (µg/kg Aroclor 1254)	32.0
Amount in Sample	27.9 U
Percent Recovery	100%

Matrix Spike (WR-A) Duplicate

Surrogate Recovery (DBC)	150%
Amount Spiked (µg/kg Aroclor 1254)	35.0
Amount Recovered (µg/kg PCB 1254)	43.0
Amount in Sample	27.9 U
Percent Recovery	120%

(a) Mean of three replicates, sd=0.0 (compounds below detection in all samples)

TABLE 3.10. Pesticides in Phase II West Richmond Cores (U=undetected above given detection limit)

SAMPLE	RECOVERY	PESTICIDE CONCENTRATON (µg/kg dry weight) Aldrin	A-BHC	B-BHC	D-BHC	Chlordane	4,4' DDD	4,4'DDE	4,4'DDT	Dieldrin
Detection Limit	N/A	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Method Blank	110%	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
WR-A (a)	130%	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U
WR-B	100%	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U
WR-C	130%	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
WR-D	140%	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U
WR-E	140%	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U
Triplicate Analysis										
WR-A Rep 1	130%	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U
WR-A Rep 2	130%	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U
WR-A Rep 3	140%	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U

SAMPLE	PESTICIDE CONCENTRATION (µg/kg dry weight) Endosulfan I	Endosulfan II	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Heptachlor	Heptachlor Epoxide	Lindane (G-BHC)	Methoxy-chlor	Endrin Ketone	Toxaphene
Detection Limit	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0	2.0	20.0
Method Blank	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	4.0 U	2.0 U	20.0 U
WR-A (a)	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	5.6 U	2.8 U	27.9 U
WR-B	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	5.6 U	2.8 U	28.0 U
WR-C	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	5.5 U	2.8 U	27.3 U
WR-D	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	2.9 U	5.8 U	2.9 U	29.2 U
WR-E	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	2.7 U	5.4 U	2.7 U	27.2 U
Triplicate Analysis											
WR-A rep 1	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	5.6 U	2.8 U	27.9 U
WR-A rep 2	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	5.6 U	2.8 U	27.9 U
WR-A rep 3	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	27.9 U

(a) Mean of three replicates, sd=0.0 (compounds below detection in all samples)

TABLE 3.11. Results of Pesticide Matrix Spikes (U=undetected above given detection limit; N/A=not applicable)

SAMPLE	PESTICIDE Aldrin	4,4' DDT	Dieldrin	Endrin	Heptachlor	Lindane (G-BHC)	SURROGATE RECOVERY
Matrix Spike (WR-A)							
Amount Spiked (µg/kg)	22.0	22.0	22.0	22.0	22.0	22.0	N/A
Amount Recovered (µg/kg)	29.0	26.0	24.0	21.0	21.0	24.0	N/A
Amount in Sample	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	N/A
Percent Recovery	130%	120%	110%	99%	93%	110%	110%
Matrix Spike (WR-A) Duplicate							
Amount Spiked (µg/kg)	24.0	24.0	24.0	24.0	24.0	24.0	N/A
Amount Recovered (µg/kg)	46.0	46.0	26.0	36.0	22.0	26.0	N/A
Amount in Sample	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	2.8 U	N/A
Percent Recovery	200%	117%	110%	160%	98%	110%	110%

3.23

Polynuclear Aromatic Hydrocarbons (PAH)

Sixteen PAH compounds were extracted and analyzed following Method 8270 in EPA Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods, SW-846 (USEPA 1986). PAH results and quality control data for the Phase II West Richmond core samples are presented in Tables 3.12, 3.13, and 3.14. The achieved detection limits were acceptably low, no analytes were detected in the method blank, and recoveries for surrogate compounds were very good, ranging from 60 to 100%. No PAH compounds were detected in any of the five Phase II West Richmond core samples.

TABLE 3.12. Polynuclear Aromatic Hydrocarbons in Phase II West Richmond Cores (U=undetected above given concentration)

COMPOUND	Detection Limit	CONCENTRATION (µg/kg dry weight) Method Blank	WR-A	WR-B	WR-C	WR-D	WR-E
Acenaphthene	10	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	10	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzo(a,h)anthracene	10	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-c,d)pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	20	20 U	20 U	20 U	20 U	20 U	20 U
Naphthalene	20	20 U	20 U	20 U	20 U	20 U	20 U
Phenanthrene	10	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10	10 U	10 U	10 U	10 U	10 U	10 U
Surrogate Recovery (%)							
Naphthalene-d8	N/A	83	89	82	84	85	60
Acenaphthene-d10	N/A	78	77	75	78	76	71
Phenanthrene-d10	N/A	81	79	78	79	75	75
Benzo(a)pyrene-d12	N/A	100	100	100	100	95	96

TABLE 3.13. Matrix Spike Data for PAH Analysis (Concentrations in g/kg dry weight; U = undetected above given concentration; N/A = not applicable)

COMPOUND	Detection Limit	Amount Spiked	Amount in Sample	Matrix Spike[a] Amount Recovered	Matrix Spike[a] Spike Recovery (%)	Matrix Spike Duplicate[a] Amount Recovered	Matrix Spike Duplicate[a] Spike Recovery (%)	MS/MSD Relative Percent Difference (RPD)[b]
Acenaphthene	5	100	5 U	120	120	120	120	0
Acenaphthylene	5	100	5 U	120	120	120	120	0
Anthracene	5	100	7	127	120	147	140	15
Benzo(a)anthracene	5	100	12	122	110	142	130	17
Benzo(b)fluoranthene	5	100	18	128	110	188	170	43
Benzo(k)fluoranthene	5	100	14	124	110	154	140	24
Benzo(a)pyrene	5	100	19	119	100	159	140	33
Benzo(g,h,i)perylene	5	100	22	109	87	132	110	23
Chrysene	5	100	14	124	110	164	150	31
Dibenzo(a,h)anthracene	5	100	5 U	140	140	140	140	0
Fluoranthene	5	100	18	128	110	138	120	9
Fluorene	5	100	5 U	130	130	120	120	8
Indeno(1,2,3-c,d)pyrene	5	100	19	119	100	159	140	33
Naphthalene	10	100	10 U	150	150	160	160	6
Phenanthrene	5	100	12	122	110	132	120	9
Pyrene	5	100	42	134	92	152	110	18
Surrogates								
Naphthalene-d8	N/A	500	99[c]	N/A	87[c]	N/A	100[c]	N/A
Acenaphthene-d10	N/A	500	89	N/A	80	N/A	88	N/A
Phenanthrene-d10	N/A	500	81	N/A	80	N/A	81	N/A
Benzo(a)pyrene-d12	N/A	500	110	N/A	120	N/A	120	N/A

(a) Matrix spike sample was not sediment from John F. Baldwin Phase II program but was analyzed by the same laboratory at the same time
(b) RPD = (|difference between replicates|)/(mean of replicates) X 100
(c) Values are percent recovery of surrogates

TABLE 3.14. Standard Reference Material PAH Results (Concentrations in g/kg dry weight; U = undetected above given concentration; NC = SRM not certified for compound; N/A = not applicable)

COMPOUND	Detection Limit	SRM HS-4 Certified Range	SRM HS-4 Rep 1 Conc.	SRM HS-4 Rep 1 In/Out of Range	SRM HS-4 Rep 2 Conc.	SRM HS-4 Rep 2 In/Out of Range	Relative Percent Difference (RPD)[a] Between Replicates
Acenaphthene	5.0	150 U	33	In	30	In	10
Acenaphthylene	5.0	150 U	150	In	150	In	0
Anthracene	5.0	140 ± 70	230	Out +10%	220	Out -5%	4
Benzo(a)anthracene	5.0	530 ± 50	520	In	500	In	4
Benzo(b)fluoranthene	5.0	700 ± 150	570	In	570	In	0
Benzo(k)fluoranthene	5.0	360 ± 50	510	Out +24%	480	Out +17%	6
Benzo(a)pyrene	5.0	650 ± 80	520	Out -9%	510	Out -11%	2
Benzo(g,h,i)perylene	5.0	580 ± 220	390	In	350	Out -3%	11
Chrysene	5.0	650 ± 80	620	In	600	In	3
Dibenzo(a,h)anthracene	5.0	120 ± 50	130	In	140	In	7
Fluoranthene	5.0	1250 ± 100	870	Out -25%	850	Out -26%	2
Fluorene	5.0	150 U	42	In	40	In	5
Indeno(1,2,3-c,d)pyrene	5.0	510 ± 150	480	In	440	In	9
2-Methylnaphthalene	10	NC	110	N/A	110	N/A	0
Naphthalene	10	150 U	78	In	78	In	0
Phenanthrene	5.0	680 ± 80	550	Out -8%	540	Out -10%	2
Pyrene	5.0	940 ± 120	720	Out -12%	680	Out -17%	6
Surrogates							
Naphthalene-d8	N/A	N/A	88[b]	N/A	74[b]	N/A	N/A
Acenaphthene-d10	N/A	N/A	93	N/A	77	N/A	N/A
Phenanthrene-d10	N/A	N/A	84	N/A	70	N/A	N/A
Benzo(a)pyrene-d12	N/A	N/A	110	N/A	940	N/A	N/A

(a) RPD = (|difference between replicates|)/(mean of replicates) X 100
(b) Values are percent recovery for surrogates

4.0 DISCUSSION

The five sites sampled during Phase II of the John F. Baldwin Ship Channel Program were located just outside and to the east of the existing channel, while the John F. Baldwin Phase I stations were inside the existing channel. The Phase II West Richmond cores were characterized as geologically and chemically very similar to the nearest Phase I cores. Compared to Phase I samples, Phase II sediments showed comparable or lower concentrations of oil and grease, petroleum hydrocarbons, metals, and butyltins. Pesticides and PCBs were not detected in either Phase I or Phase II West Richmond sediments.

The most noticeable difference was in the PAH values of sediment cores from the central part of the West Richmond reach of the channel, where the upchannel direction changes from northwest to north (refer to Figure 3.1). No PAHs were detected in any Phase II West Richmond sediments, while PAH levels of 1-3 mg/kg (ppm) were measured at the three nearest Phase I stations (WR IV R, WR IV.5 C, and WR V L) (Word and Kohn 1990). Phase II stations WR-D and WR-E were located approximately 1000 ft east of those Phase I stations; Phase II station WR-C was approximately 2000 ft east.

Concentrations of PAH, total organic carbon, and percent clay for Phase II stations and nearby Phase I stations are compared in Table 4.1. It appears that detection of PAH in WR IV R, WR IV.5 C, and WR V L may be correlated with a higher proportion of fine-grained sediments (clay). The relationship of PAH to organic carbon shows no such correlation, as Phase II samples showed TOC values as high as those Phase I samples where PAH was detected. Further north in the channel, PAHs were undetected in both Phase I and Phase II stations (WR III L, WR III C, WR II L, WR-A, and WR-B). While there is no reason to expect adverse biological effects due to PAH in sediment removed from the Phase II sampling area, there may be increased potential for transport of PAH into the area once it is dredged, if the source of PAH to the Phase I sites is still active.

TABLE 4.1. Comparison of PAH, Core Length, Percent Clay, and TOC in West Richmond Sediments, John F. Baldwin Phases I and II (MW = molecular weight; ND = not detected)

STATION	Length of Vertical Core in Sample (ft)	% Clay (dry wt)	% TOC (dry wt)	PAH Conc. (µg/kg dry wt) Low MW	High MW	Total
Phase II						
WR-A	10.2	13	0.53	ND	ND	ND
WR-B	12.2	15	0.62	ND	ND	ND
WR-C	12.5	11	1.17	ND	ND	ND
WR-D	4.6	19	0.86	ND	ND	ND
WR-D	6.1	12	0.71	ND	ND	ND
Phase I						
WR II L (0-6.9′)	6.9	10	0.49	ND	ND	ND
WR III C (0-6.4′)	6.4	13	0.44	ND	ND	ND
WR III L (0-6.6′)	6.6	10	0.46	ND	ND	ND
WR IV R (0-6′)	6.0	37	0.92	249	1580	1829
WR IV R (6-11.5′)	5.5	15	0.40	108	366	474
WR IV.5 C (0-4′)	4.0	26	0.76	371	1412	1783
WR V L (0-6′)	6.0	32	1.05	709	2366	3075

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APPENDIX A

MATERIALS AND METHODS USED FOR
THE DESCRIPTION OF SEDIMENT CORES

A.1 MATERIALS

The following is a checklist of items and materials useful for the examination and description of sediment cores.

- ASTM Procedure D 2488-84
- Stainless-steel knife
- Hand lens (10X magnification)
- 10 N Hydrochloric acid (HCl)
- Ruler (scaled in 0.1-foot increments)
- Blank log forms (see Figure A.1)
- Clipboard
- AGI Data Sheets
- Munsell Color Charts

In addition, the charts and/or reference materials listed in Table A.1, and included in this appendix, are useful in the description of specific sediment characteristics.

A.2 METHODS

Descriptions of the physical, chemical, and biological features preserved in sediments aid in the interpretation of the types of geologic processes active both during and after the sediment was deposited. A total of 17 sediment characteristics, outlined in ASTM (1984), are commonly used to describe inorganic soils. These are listed in Table A.2.

Moisture condition was not routinely logged because of the saturated nature of the sediments. Furthermore, since particles were rarely larger than coarse sand, neither were angularity, particle shape, range in particle size, and hardness logged. For this reason, these sediment characteristics were not included in the log form used for the description of John F. Baldwin sediments (Figure A.1). However, in the few instances where these characteristics did apply, they were described under the "COMMENTS" column.

The definition of "soil" from the engineers standpoint (ASTM, 1984), includes any unconsolidated sediment. The geologic definition of soil is slightly different and restricts soils to those sedimentary deposits that have undergone alteration near the land's surface by either physical, chemical, and/or biological processes; therefore, in a strict sense, not all sediments are soils. For the purposes of this discussion, however, "soils" and "sediments" will be used synonymously.

Core Data Log

Core #: Logger: Date: Page of

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
	0													
	5													
	10													
	15													

FIGURE A.1. Log Form Used to Record Sediment Descriptions

TABLE A.1. Charts and Other Reference Materials Used to Provide Standardized Descriptions of Sediment Characteristics.

CHART/REFERENCE	PURPOSE	FIGURE #
• Percentage Estimate Chart	Estimate percentage of individual particles or constituents	A.2
• Roundness Scale	Roundness of sand and coarser particles	A.3A
• Sorting Chart	Estimate of grading	A.3B
• Particle Shape	Reference to describe particle shape	A.4
• Munsell Soil Color Charts	Soil color	A.5
• Unified Soil Classification System	Method for designating sediment type	A.6, A.7
• Grain-size Scales	Range of particle sizes; maximum particle size	A.8, A.9
• Lithologic Symbols	Graphic patterns for lithologic log	A.10, A.11

TABLE A.2. Sediment characteristics identified in ASTM Procedure D2488-84.

1) angularity *
2) particle shape *
3) color
4) odor
5) moisture condition
6) HCl reaction
7) consistency (i.e., firmness)
8) cementation *
9) structure
10) sediment classification type (i.e., lithology)
11) range of particle sizes *
12) maximum particle size
13) hardness *
14) dry strength **
15) dilatancy **
16) toughness **
17) plasticity **

* Applies to coarse-grained sediment (sand and larger particles)
** Applies to fine-grained sediment of mostly silt and/or clay
Features not generally logged for this study are underlined

A.3

It is sometimes helpful to provide an estimate of the relative proportions of different constituents in sediments (e.g. light- versus dark-colored minerals). This is made easier and more accurate by using a percentage estimate chart, which provides a graphic reference with varying concentrations of a particular constituent (Figure A.2).

The criteria used to describe each of the 17 sediment characteristics identified in ASTM (1984) are discussed below.

A.2.1 Angularity

The angularity of sedimentary particles is a reflection of the sedimentary environment and the amount of time that has elapsed before deposition and burial. A chart showing how to classify the angularity of sedimentary particles is presented in Figure A.3A. A range of angularity may be stated, such as: subrounded to rounded.

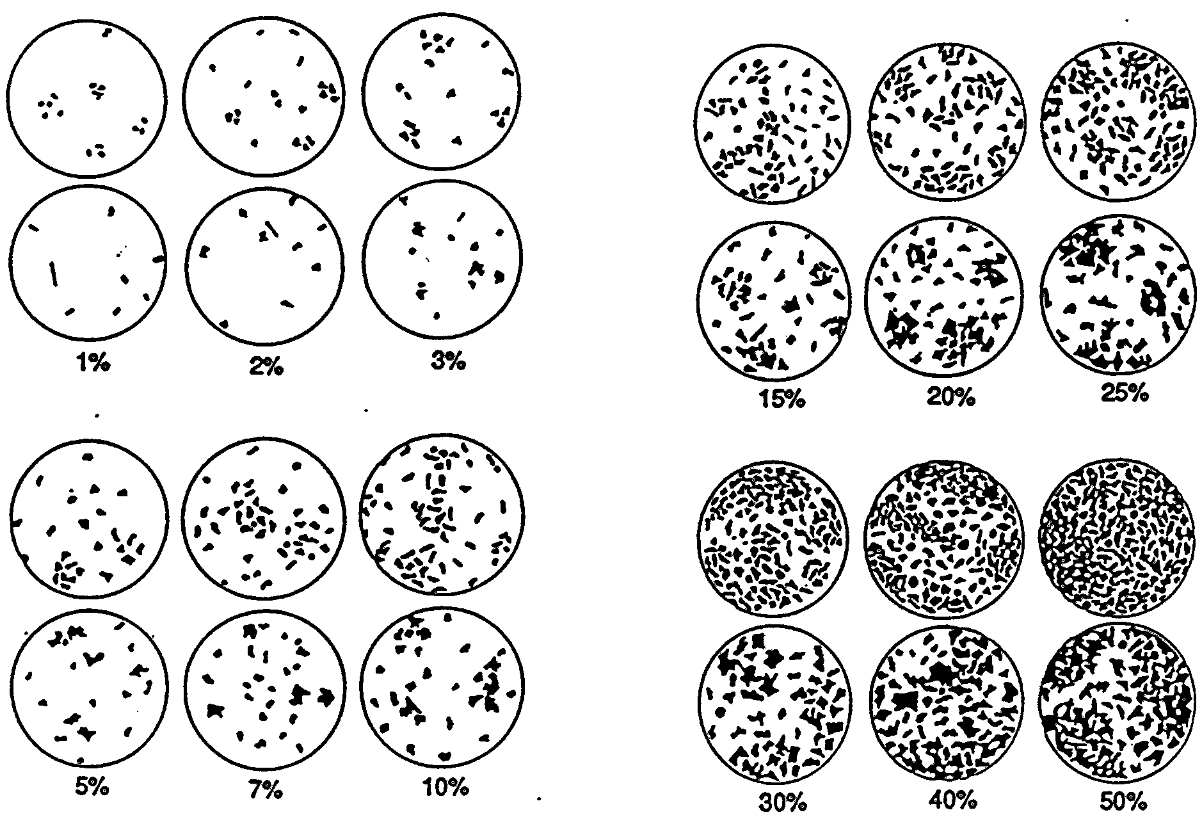

FIGURE A.2. Comparison Chart Used to Estimate the Percentages of Constituents (from AGI 1982)

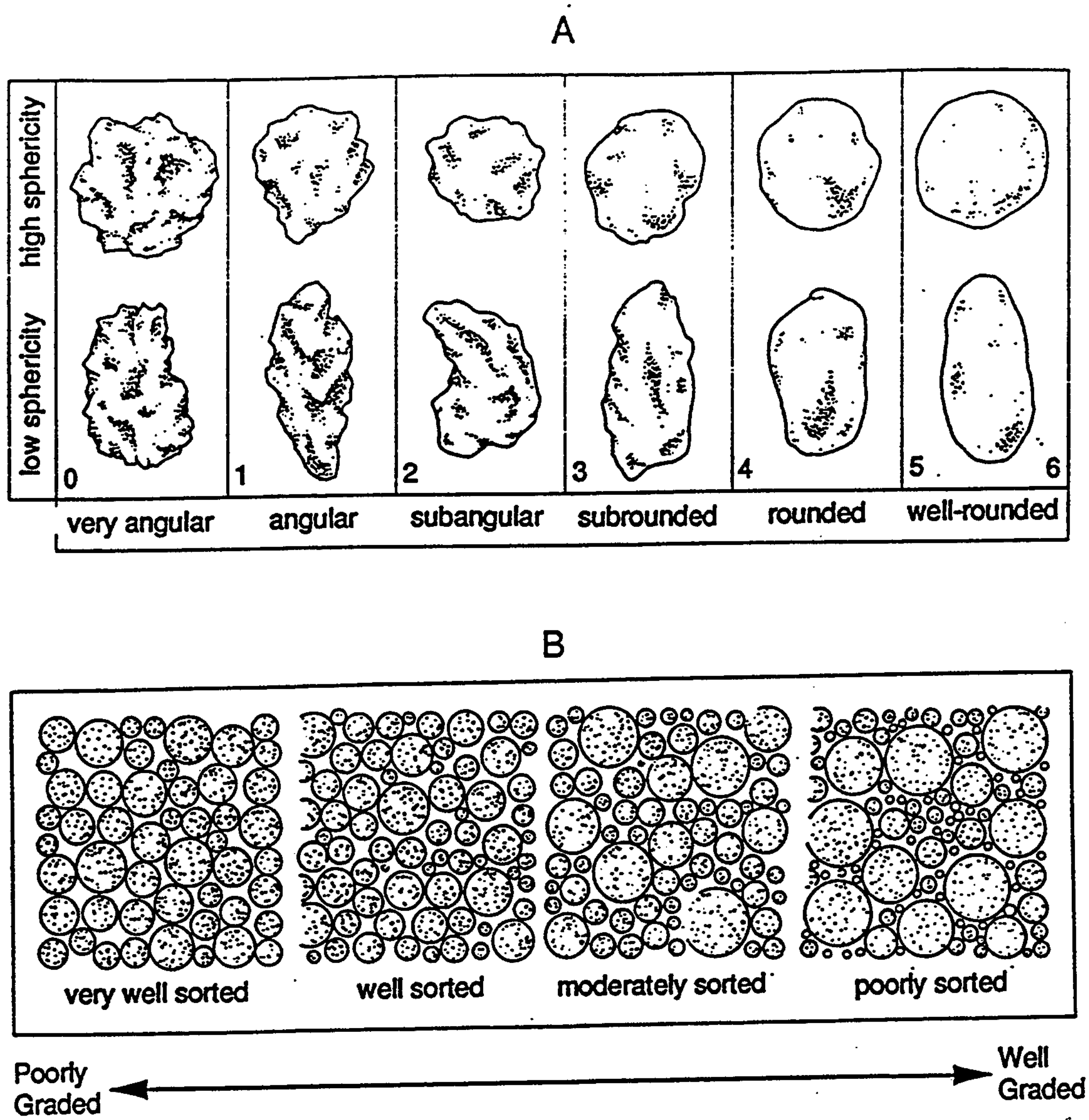

FIGURE A.3. Charts Used to Visually Estimate (A) Roundness/Sphericity and (B) Sorting/Grading

A.2.2 Shape

Shapes of sedimentary particles often reflect the internal characteristics (e.g., preferential parting) of the material or sometimes the type of sedimentary environment. For example gravel clasts deposited in high-energy environments, such as beaches and river bottoms, are often worn flat.

According to Figure A.4, gravel-sized clasts may be described in one of four ways. First, if the ratio of the clast's width to thickness is >3, it is classified as flat. Second, if the ratio of the clast's length to width is >3, the clast is elongate. Third, if both criteria apply the clast is both flat and elongate. And last, if none of the criteria apply, then shape is not mentioned. Indicate the fraction of the clasts that have the shape, such as: one-third of gravel clasts are flat. Particle shape did not apply to most of the sediments logged during this project and the few pebbles that were observed were neither flat nor elongate.

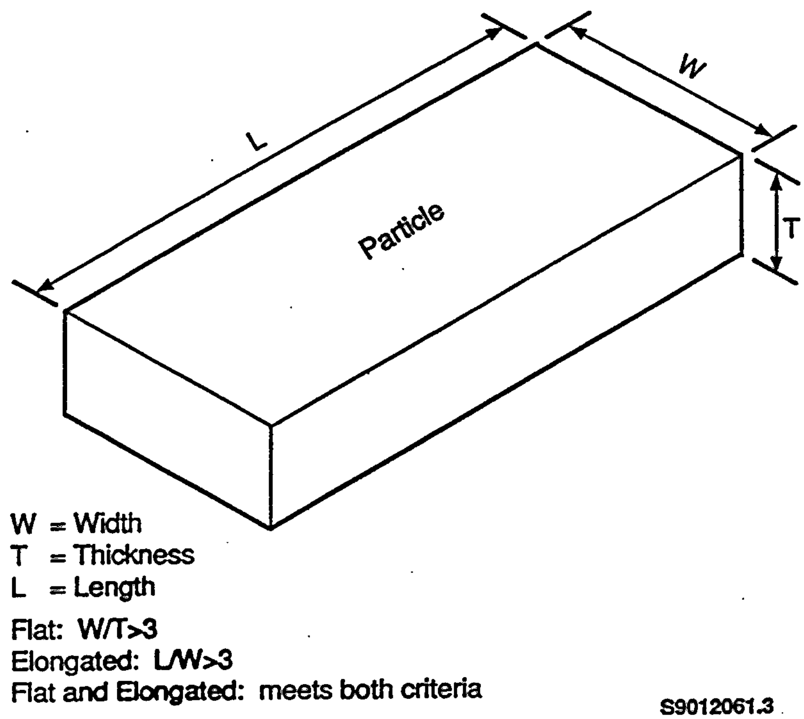

FIGURE A.4. Criteria Used to Describe Particle Shape of Pebbles and Large Gravels (From ASTM 1984)

A.2.3 Color

Color may be useful in identifying materials of similar geologic origin. For example, color was often a useful criteria for differentiating Younger Bay Mud from Older Bay Mud. Sediment color was determined by comparing the wet sediment with standard sediment colors given in Munsell (1975). The advantage to using the Munsell soil color system is that it provides a consistent, standardized method for describing color and subjectivity is minimized.

The Munsell color notation consists of three simple variables that combine to describe all colors known in the Munsell soil color system. The three variables are: hue, value, and chroma (Figure A.5). The hue notation indicates the relation of the sediment color with respect to red, yellow, green, blue and purple; the value notation indicates its lightness, and the chroma notation indicates its strength (i.e., intensity).

Color can be described either by the Munsell notation (e.g. 5YR 5/3; hue=5YR, value=5, chroma=3) or by its equivalent color name (e.g. reddish brown). Both the color name and Munsell notation were recorded on core logs (see Appendix B). Only rarely was there not a reasonable match between the true color of the core sediment and one of the colors on a Munsell color chart.

A.2.4 Odor

Odors may indicate the presence of contaminants or be the result of the geochemical environment. Odors most frequently noted were that of petroleum hydrocarbons and the smell of rotten eggs (an indication of the presence of hydrogen sulfide). Both of these odors were restricted to the Younger Bay Mud unit. Petroleum odors may be the result of contamination of the sediments by shipping spills or industrial waste, or perhaps is derived from the abundant decaying organic matter present in these sediments. Hydrogen sulfide is a common natural by-product in chemically reducing environments such as the Richmond Harbor estuary.

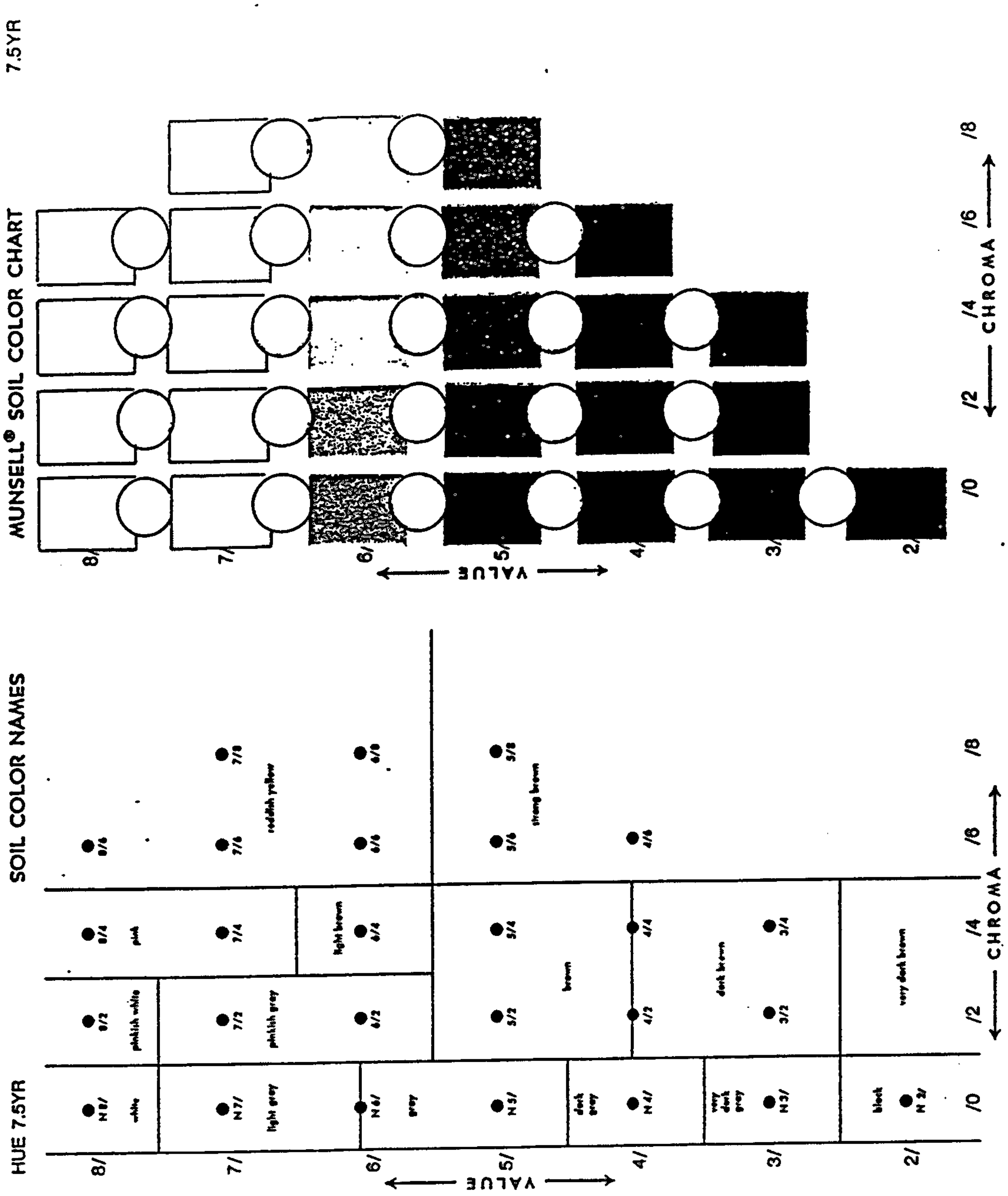

FIGURE A.5. Example of a Page from the Munsell Soil Color for Hue 7.5YR

A.8

A.2.5 Moisture Condition

Moisture condition is described as either dry, moist, or wet according to the following criteria:

DRY Absence of moisture, dry to the touch

MOIST Damp but no visible water

WET Visible free water, usually soil is below water table (i.e., saturated)

All the sediments logged for this project were taken from below sea level and did not lose any significant moisture between the time they were drilled and logged. Therefore, they are all classified as wet.

A.2.6 HCl Reaction

The reaction (i.e., effervescence) of sedimentary material, as a result of adding dilute hydrochloric acid, is an indication of the presence of calcium carbonate. Calcium carbonate in sediments may be derived from a variety of sources including: 1) physical disintegration of preexisting carbonate rocks (e.g., limestone, marble), 2) biogenic precipitation (e.g., shell, bone), and 3) soil development. In the last example, calcium carbonate concentrations, often referred to as caliche or calcrete, may accumulate over time near the land's surface in arid climates. Where calcium carbonate concentrations occur in combination with other evidence for soil development, such as root traces and oxidation, then a pedogenic (soil forming) origin is favored. Criteria for describing the reaction with 10 N HCl are as follows:

NONE No visible reaction

WEAK Some reaction, with bubbles forming slowly

STRONG Violent reaction, with bubbles forming immediately

A solution of 10 N HCl is obtained by slowly adding one part of concentrated hydrochloric acid to three parts of distilled water. (To avoid a violent exothermic reaction never add water to acid).

A.2.7 Consistency

Consistency is a measure of the firmness or consolidation of sedimentary material. In general, there is a direct relationship between consistency and age of the deposit (i.e., older deposits are usually more firm because of compaction and/or cementation). Consistency is most applicable to fine-grained sediments and least applicable on sediments that contain significant amounts of gravel. The criteria used to determine consistency are as follows:

VERY SOFT	Penetrometer penetrates soil greater than 4 cm
SOFT	Penetrometer penetrates soil 2.0 to 4.0 cm
FIRM	Penetrometer penetrates soil 0.25 to 2.0 cm
HARD	Penetrometer penetrates soil less than 0.25 cm

The penetrometer used for sediment core descriptions consists of a 6-in. nail spike attached to a clay brick for a total mass of 2.0 kg; the nail spike is marked in centimeter increments to quantify the amount of soil penetration.

A.2.8 Cementation

Often sedimentary particles are held together with a binding cement. Three common natural cements are calcium carbonate (lime), silica, and iron-oxide compounds. Particles cemented with calcium carbonate effervesce in the presence of hydrochloric acid (see Section A.2.6 above). Sediments cemented with iron oxide are usually some shade of red, yellow, or brown. Usually there is a relationship between consistency (Section A.2.7) and cementation, in that strongly cemented deposits are also hard to very hard. Criteria used to describe the degree of cementation are:

WEAK	Crumbles or breaks with handling or light finger pressure
MODERATE	Crumbles or breaks with considerable finger pressure
STRONG	Will not crumble or break with finger pressure

A.2.9 Structure

Structures are features that originate within the layers of sediment or at the sediment/water interface in response to various physical, biologic

and/or chemical processes. Structures may be classified into two categories: primary and secondary. Primary structures form as the sediment is being deposited (e.g., lamination, stratification). Secondary structures form after deposition, often as a result of compaction or other stresses (e.g., fissured, slickensided), biologic activity (e.g., root traces, mottling), and soil development (e.g., homogeneous, blocky, mottled). The following are some common structures observed in sedimentary deposits.

PRIMARY STRUCTURES

STRATIFIED	Alternating layers of varying material or color with layers at least 6 mm thick
LAMINATED	Alternating layers of varying material or color with the layers less than 6 mm thick
LENSED	Inclusion of small pockets of different sediment type, such as small lenses of sand scattered through a mass of clay. (This type of structure may also be secondary).

SECONDARY STRUCTURES

FISSURED	Breaks along definite planes of fracture with little resistance to fracturing
SLICKENSIDED	Fracture planes appear polished or glossy, sometimes striated
BLOCKY	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
MOTTLED	Variation in color of sediments as represented by localized spots or blotches of color or shades of color
HOMOGENEOUS	Same color and appearance throughout

A.2.10 Sediment Classification Type

The classification method used in this study is the Unified Soil Classification System, which consists of a two-letter designation for most soils (i.e., unconsolidated sediments). A simplified version of the Unified Soil Classification System is presented in Figure A.6, while a more-detailed breakdown is presented in Figure A.7.

Major Divisions			Group Symbols	Description
Coarse-Grained Sediments More than half of particles are larger than very fine sand	≥50% Gravel	Clean Gravels	GW	Well-graded (i.e., poorly sorted) gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded (i.e., well sorted) gravels, gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	≥50% Gravel	Clean Sands	SW	Well-graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands, gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Sediments More than half of particles are smaller than very fine sand	Silts and Clays	Low Liquid Limit	ML	Silts and very fine sands, silty or clayey fine sands, or clayey silts, with slight plasticity
			CL	Clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		High Liquid Limit	MH	Silts or fine sandy silts with moderate plasticity
			CH	Clays of high plasticity, fat clays

S9012061.1

FIGURE A.6. Abbreviated Form of the Unified Soil Classification System (From AGI 1982)

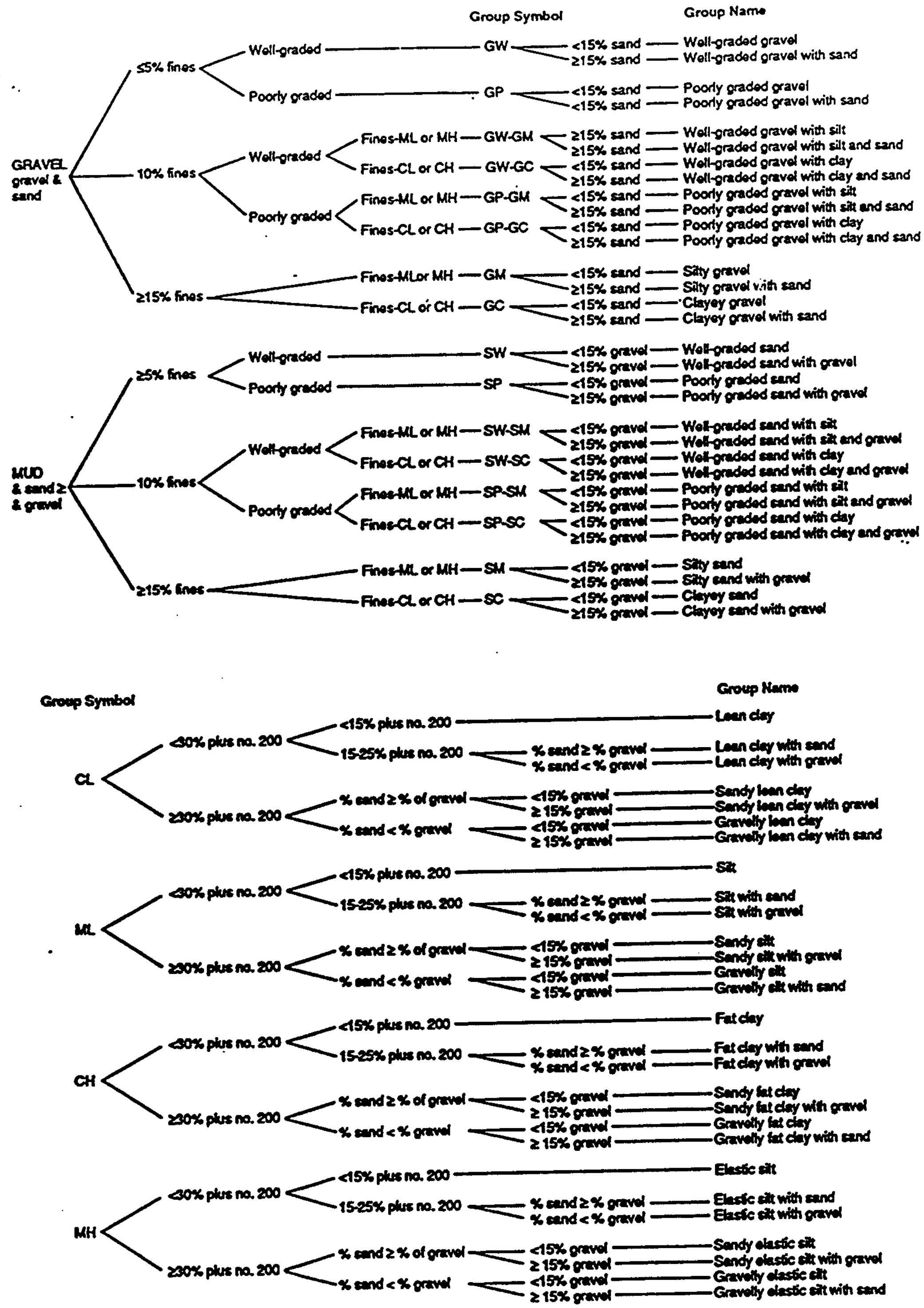

FIGURE A.7. Detailed Flow Chart For the Classification of Coarse- and Fine-Grained Soils Using the Unified Soil Classification System

A.13

According to the Unified Soil Classification System, coarse-grained sediments are classified based on grain-size distribution and grading (i.e., sorting), while fine-grained sediments are classified on the basis of grain size and liquid limit vs. plasticity.

Particle-size distribution may be determined with precision using laboratory methods (e.g., sieving of sand and coarser particles; pipette or hydrometer analysis of silt and clay). Because these methods are expensive and time-consuming, it is more desirable to estimate grain size using rapid visual-manual techniques described below. For example, sand and coarser particles are most easily identified via comparison with standard charts of grain size (Figures A.8 and A.9). Fine-grained soils, consisting of mostly silt and/or clay, on the other hand, are identified based on manual tests of their dry strength, dilatancy, toughness, and plasticity (Figure A.10).

In the Unified Soil Classification System, the first letter of the sediment-type symbol represents the predominant grain-size interval, be it gravel (G), sand (S), silt (M), or clay (C). For coarse-grained sediments, the first letter (i.e., G or S) may be followed by a descriptor of grading, either W (well graded) or P (poorly graded), or a secondary grain-size descriptor (M or C). The definition of grading is opposite that of sorting, a common geologic term. For example, a clean, well-sorted sand, consisting of particles over a narrow range in grain size, is referred to as poorly graded in the Unified Soil Classification System and would receive the designation "SP". The relationship between grading and sorting is shown graphically in Figure A.3B. The second letter in the fine-grained soil designation consists of either L (low liquid limit) or H (high liquid limit).

The lithology column on the geologic log (Figure A.1) essentially represents a graphic display of sediment type, which can be utilized for quick easy reference and comparison between different cores and thus make interpretations easier. Examples of lithologic symbols in common use are presented in Figure A.11. Additional symbols may be used as long as they are graphically representative of the feature and are specifically defined and identified in a key that accompanies lithologic logs.

Grade Limits			inches	U.S. Standard Sieve Series	Grade Name		
phi	mm	mm					
-12	4096		161.3		very large	Boulders	GRAVEL
-11	2048		80.6		large		
-10	1024		40.3		medium		
-9	512		20.2		small		
-8	256		10.1		large	Cobbles	
-7	128		5.0		small		
-6	64		2.52	63 mm	very coarse	Pebbles	
-5	32		1.26	31.5 mm	coarse		
-4	16		0.63	16 mm	medium		
-3	8		0.32	8 mm	fine		
-2	4		0.16	No. 5	very fine		
-1	2		0.08	No. 10	very coarse	Sand	SAND
0	1		0.04	No. 18	coarse		
+1	1/2	0.500		No. 35	medium		
+2	1/4	0.250		No. 60	fine		
+3	1/8	0.125		No. 120	very fine		
+4	1/16	0.062		No. 230	coarse	Silt	MUD
+5	1/32	0.031			medium		
+6	1/64	0.016			fine		
+7	1/128	0.008			very fine		
+8	1/256	0.004			coarse	Clay Size	
+9	1/512	0.002			medium		
+10	1/1024	0.001			fine		
+11	1/2048	0.0005			very fine		
+12	1/4096	0.00025					

FIGURE A.8. Grain-size Scale Used to Determine Sedimentary Particle Size

A.15

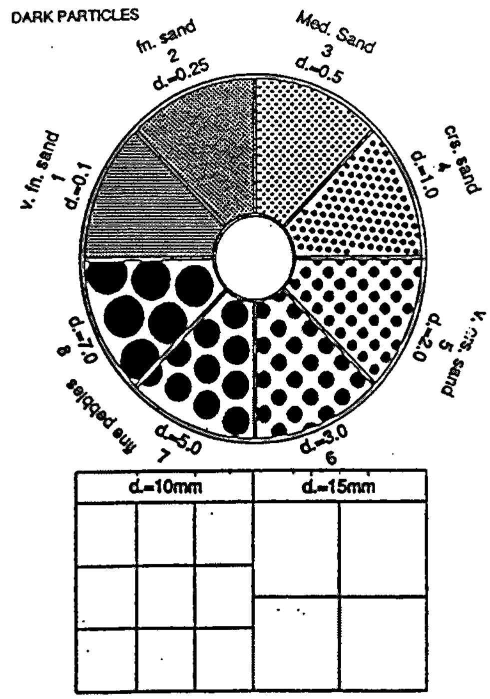

FIGURE A.9. Comparison Chart Used to Distinguish Among Sand to Pebble-size Particles (From AGI 1982). For larger particles, refer to Figure A.8; for smaller particles, refer to Sections A.2.13 and A.2.16 in this Appendix

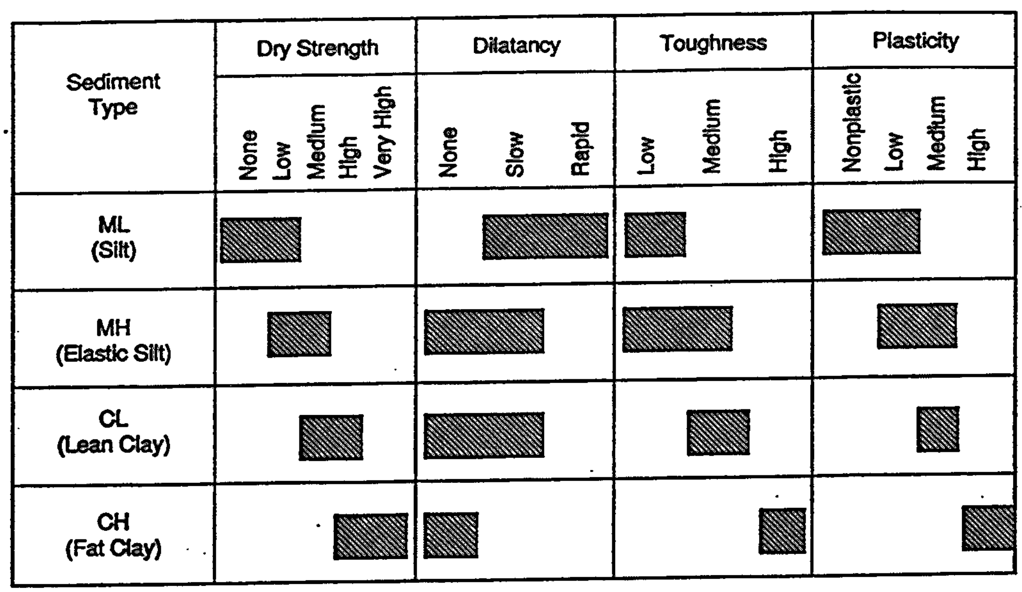

FIGURE A.10. Identification of Inorganic Fine-grained Soils From Manual Tests

A.16

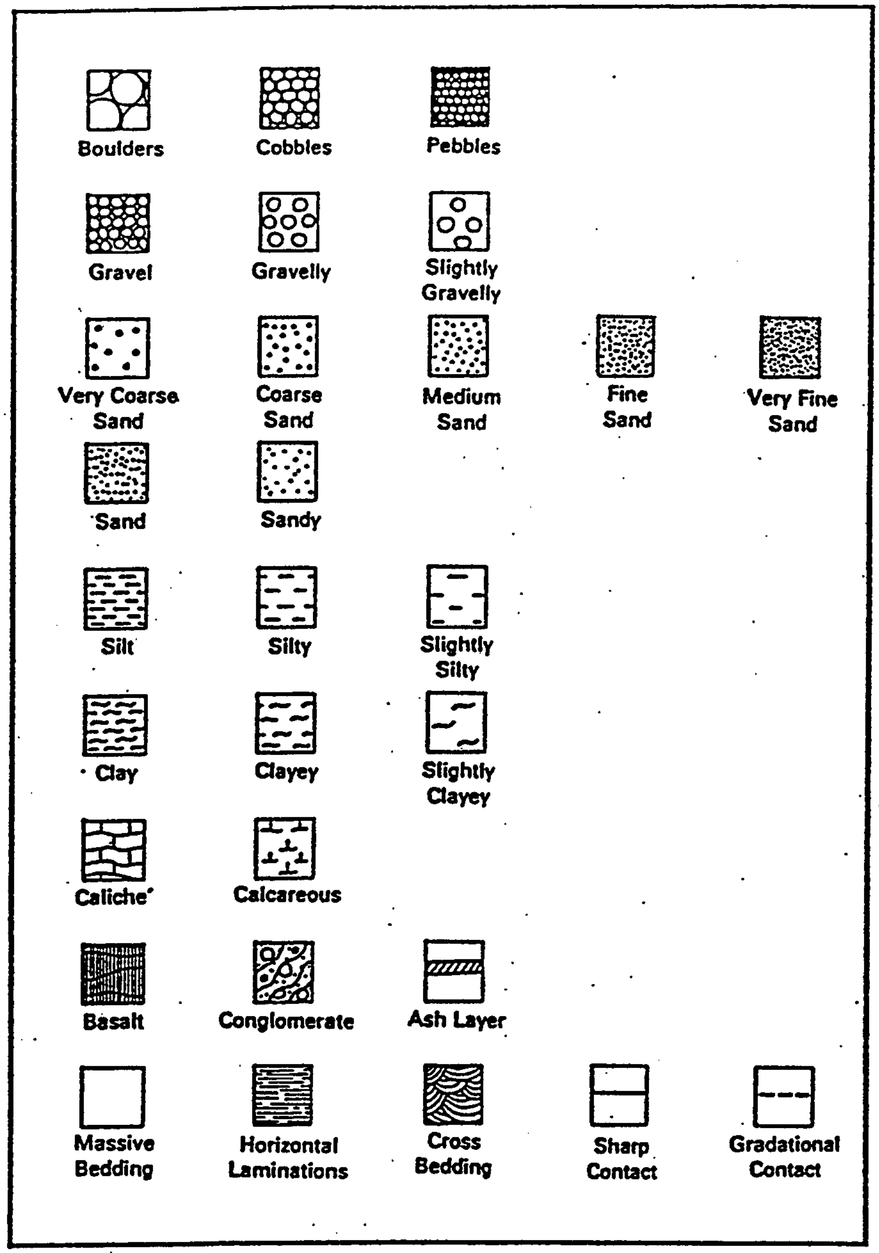

FIGURE A.11. Lithologic Symbols Used on Core Log Forms

A.17

A.2.11 Range of Particle Sizes

For gravel- and sand-sized particles, the range of particle sizes within each component is defined. For example, 20% fine to coarse gravel, 40% fine to coarse sand. The sizes of particles corresponding to the different size components are presented in Figures A.8 and A.9.

A.2.12 Maximum Particle Size

Maximum particle size is significant because it gives a general indication of the amount of turbulence or energy associated with deposition. If the maximum particle size is sand, it should be described as either fine, medium, or coarse sand. If the maximum particle size is in the gravel range, the largest particle is measured and its width recorded along the narrowest axis. The sizes of particles corresponding to the different size components are presented in Figures A.8 and A.9.

The maximum grain size observed for the Younger Bay Muds ranged from silt to medium sand, while the Older Bay Mud usually ranged from fine sand to coarse sand. The largest particles observed anywhere were fine pebbles in the Older Bay Mud unit.

A.2.13 Dry Strength

Dry strength, along with dilatancy, toughness, and plasticity are physical characteristics used to distinguish fine-grained inorganic soils, consisting of mostly silt and/or clay. Basically, the more clay present in a soil the greater its dry strength (Figure A.10). To perform a manual test of dry strength enough material must be selected in order to mold into a ball about 1 in. in diameter. Mold the material until it has the consistency of putty, adding water if necessary. From the molded material, make at least three test specimens each about 1/2 in. in diameter. Allow the test specimens to dry in air, sun or by artificial means, as long as the temperature does not exceed 60°C (ASTM, 1984). The criteria for determining dry strength are as follows:

NONE — The dry specimen crumbles into powder with mere pressure of handling

LOW — The dry specimen crumbles into powder with light finger pressure

MEDIUM The dry specimen breaks into pieces or crumbles with considerable finger pressure

HIGH The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface

VERY HIGH The dry specimen cannot be broken between the thumb and a hard surface

Dry strength was determined for John F. Baldwin cores by sampling selected intervals and allowing the samples to air dry overnight. Dry strength was determined the next day and noted in the comments column of the geologic log.

A.2.14 Dilatancy

Dilatancy is a measure of how easily a soil gives up water when shaken. For example, some clays have the ability to absorb and retain large amounts of water into their crystal lattice. "Fat" clays tend to retain their water even under stress whereas "lean" clays and silt tend to release water when shaken.

To test for dilatancy select enough material to mold into a ball about 1/2 in. in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky consistency. Smooth the soil ball in the palm of the hand with a blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction. Specimens with high dilatancy will quickly yield water when shaken and absorb water when squeezed. The criteria for describing dilatancy are:

NONE No visible change in the specimen

SLOW Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing

RAPID Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

The range of dilatancy for the different fine-grained sediment types is shown in Figure A.10. From this figure it is apparent that dilatancy decreases with decreasing grain size.

A.2.15 Toughness

After completion of the dilatancy test, shape the same specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 in. The thread will crumble at a diameter of 1/8 in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading and classify into one of the following categories.

LOW	Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft
MEDIUM	Medium pressure is required to roll the thread to near the plastic limit. The thread and lump have medium stiffness.
HIGH	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

The range of toughness for the different fine-grained sediment types is shown in Figure A.10. From this figure it is apparent that toughness increases with a decrease in particle size.

A.2.16 Plasticity

On the basis of observations made during the toughness test, describe the plasticity of the material according to the following criteria:

NONPLASTIC	A 1/8 in. thread cannot be rolled at any water content
LOW	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.

MEDIUM	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
HIGH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

The range of plasticity for the different fine-grained sediment types is shown in Figure A.10. From this figure it is apparent that an increase in plasticity accompanies a decrease in grain size.

A.3 REFERENCES

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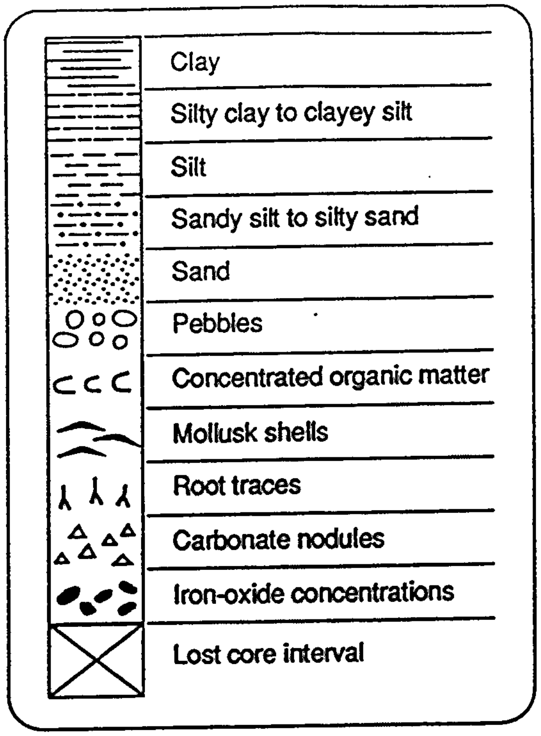
APPENDIX B

JOHN F. BALDWIN SHIP CHANNEL PHASE II GEOLOGICAL CORE LOGS OF WEST RICHMOND CORES

John F. Baldwin

Key to Core Data Logs (After ASTM Procedure D2488-84)

Lithology



Type:
See soil group classification in ASTM D2488-84

Color (wet):
Selected from Munsell Soil Color Chart

Consistency:
<0.25 cm = hard
0.25 - 2.0 cm = firm
2.0 = 4.0 cm = soft
>4.0 cm = very soft

Cementation:
N = not cemented
W = weakly cemented
M = moderately cemented
S = strongly cemented

Clay/Silt Characteristics

Dilatancy:
N = none
S = slow
R = rapid

Toughness:
L = low
M = medium
H = high

Plasticity:
N = none
L = low
M = medium
H = high

Structure:
S = stratified
L = laminated
F = fissured
Sl = slickensided
Ln = lensed
Bl = blocky
M = mottled
H = homogeneous

HCl Reaction:
N = none
W = weak
S = strong

Maximum Particle Size:
VCP = very coarse pebble
CS = coarse sand
MS = medium sand
FS = fine sand

Odor:
N = none
S = sulfide
P = petroleum
O = other

B.1

Core Data Log

Core #: WRA *Logger:* Cadoret/Barton *Date:* 9/26/90 *Page* 1 *of* 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
36.8	0		S	M	M	SP/MH	5Y3/2	VS	N	M	N	MS	N	Wood Chips
														Shell Hash
										S				
							5Y3/2/5Y2.5/2							
										M				
41.8	5						5Y3/2	F VS						
			R	M	M	MH/SP								Medium Dry Strength
														Wood Chips
46.3	10													

5Y3/2 = olive gray
5Y2.5/2 = black

S9012037.34

B.2

Core Data Log

Core #: WRB *Logger:* Bjornstad/Barton *Date:* 9/26/90 *Page* 1 *of* 1

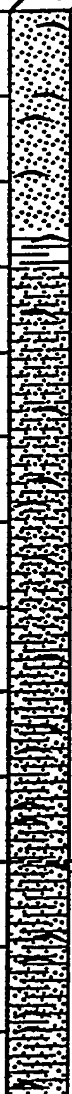
Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
34.8	0		N/A	N/A	N/A	SW	5Y4/2 dk. olive gray	VS	N	M	N	CS	N	Shell Hash
			S	M	M	SW/CL w/Sand								
												MS		
39.8	5													
														High Dry Strength
	10													
47.3	12.5													

S9012037.35

B.3

Core Data Log

Core # WRC | *Logger:* Cadoret/Barton | *Date:* 9/26/90 |



Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
34.5'	0		N/A	N/A	N/A	SW	5Y3/2		N	H	N	VFP	N	Shell Hash
								F						
								H						
			S	M-H	H	CH		F		M		VFS		Very high, dry strength
			N/A	N/A	N/A	SW/ ML		VS				VCS		
								F/VS				MS		
								S						
	5		S	M	M	SW/ MH						VFP		
								F						
					H	SW/ CL								
						CL/ SW		S		S		MS		
							5Y3.5/2	VS						
	10						5Y3.5/2 (Mottled)							
										M		VCS		
47.3	12.8'													
	15													

5Y3/2 = dk olive gray
5Y3.5/2 = olive Gray

S9012037.37

B.4

Core Data Log

Core #: WRD *Logger:* Cadoret/Barton *Date:* 9/26/90 *Page* 1 *of* 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
42.4	0		R	L	L	ML w/Sand	5Y3/2	VS	N	M	N	VFP	N	Poorly sorted well graded
										H		MS		High Dry Strength
			S		M	MH								
			R		L	ML	5Y2.5/2			M		VFP		
							5Y3/2							High Dry Strength
47.1	4.7													
	5													
	10													

5Y3/2 - dk. olive gray
5Y2.5/2 - black

S9012037.33

B.5

Core Data Log

Core #: WRE *Logger:* Bjornstad *Date:* 9/26/90 *Page* 1 *of* 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Comments
40.9	0		N/A	N/A	N/A	SW	5Y4/2	H	N	H	N	MS	N	Shell Hash
						SW/ML	5Y4/2 mottled w/ 5Y5/2	F VS		M				
						SW	5Y4/2							
						ML/SW				H				
44.9							5y4/2 mottled w/ 5Y5/2	F VS		M				
	5													
47.4	6.5													

5Y4/2 = olive gray
5Y5/2 = olive gray

S9012037.36

B.6

Appendix A2
Chemical Characterization

SEDIMENT DATA (CF#232) 8/24/91
Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND
Sponsor: SKOGERBOE

SEDIMENT METAL DATA

(Concentrations in mg/kg Dry Weight)

Battelle Code	Sponsor Code	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
232-1	WR-PL-BAT	0.106	11.0	0.28	204	28.5	0.184	79	14.0	0.15	78
232-2	WR-LAB-BAT	0.112	8.5	0.29	212	30.5	0.163	81	15.3	0.14	81
232-3	WR-EL-BAT	0.098	10.7	0.26	187	31.9	0.186	81	14.7	0.14	83
232-4	WR-AC-BAT	0.186	8.4	0.28	179	24.0	0.128	76	13.9	0.15	75
232-5	WR-LE-BAT	0.088	9.4	0.24	248	27.1	0.157	75	14.5	0.14	76
232-6	RH-SR-BAT	0.247	7.8	0.73	188	52.7	0.269	80	27.3	0.21	111
232-7	RH-LAB-BAT	0.257	9.0	0.70	183	50.6	0.29	79	29.8	0.14	116
232-8	RH-EL-BAT	0.258	7.5	0.70	192	65.8	0.315	78	30.1	0.21	117
232-9	RH-LE-BAT	0.271	9.5	0.66	182	56.4	0.298	86	29.2	0.14	124
232-10	PS-C4-ACBAT	0.088	15.1	0.29	251	47.2	0.148	91	14.2	0.28	95
232-11	PS-C4-LABBAT	0.072	14.8	0.25	208	50.6	0.272	87	14.7	0.21	85
232-12	PS-C4-LEBAT	0.114	16.6	0.26	211	53.7	0.379	93	15.0	0.14	96
232-13	PS-C4-PLBAT	0.106	12.3	0.29	223	49.9	0.234	100	37.1	0.14	96
232-14	PS-C4-ELBAT	0.078	10.0	0.27	158	45.6	0.157	102	13.4	0.14	91

STANDARD REFERENCE MATERIAL

		Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
	MESS-1 (10/16)		10.1	NA	78	25.3	0.184	30.2	32.4	0.28	180.3
	CERTIFIED VALUE!	NC	10.6	0.59	71	25.1	0.171	29.5	34	0.34	191
			(+/-1.2)	(+/- 0.1)	(+/- 11)	(+/- 3.8)	(± .014)	(+/- 2.7)	(+/- 6.1)	(+/- .06)	(+/- 17)

U indicates that analyte was not detected above detection limit shown.
NC indicates not certified

232sed

SEDIMENT DATA (CF#232) 2/6/91
Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND
Sponsor: SKOGERBOE

SEDIMENT BUTYLTIN RESULTS

(Concentrations in ug/kg Dry Weight)

Sample Code	Sponsor Code	TETRA-BUTYLTIN	TRI-BUTYLTIN	DI-BUTYLTIN	MONO-BUTYLTIN	% Surrogate Recovery PROPYLTIN (1)
232-1	WR-PL-BAT	0.7 U	1.0	0.7 U	0.6 U	37%
232-2	WR-LAB-BAT	0.5 U	1.0	0.7	0.5 U	37%
232-3	WR-EL-BAT	0.8 U	1.3	0.7 U	0.7 U	33%
232-4	WR-AC-BAT	0.9 U	1.3	0.8 U	0.8 U	42%
232-5	WR-LE-BAT	0.6 U	1.1	0.6 U	0.6 U	35%
232-6	RH-SR-BAT	0.6 U	5.7	5.0	1.7	36%
232-7	RH-LAB-BAT	0.8 U	5.6	6.6	1.7	30%
232-8	RH-EL-BAT	0.6 U	7.3	6.6	2.6	35%
232-9	RH-LE-BAT	0.8 U	6.8	5.7	2.0	35%
232-10	PS-C4-ACBAT	0.7 U	1.1	0.7 U	0.7 U	31%
232-11	PS-C4-LABBAT	0.6 U	1.1	0.6 U	0.5 U	16%
232-12	PS-C4-LEBAT	0.7 U	1.2	0.7 U	0.7 U	26%
232-12 REP	PS-C4-LEBAT REP	0.8 U	1.5	0.7 U	0.7 U	37%
232-13	PS-C4-PLBAT	0.6 U	1.0	0.8	0.5 U	26%
232-14	PS-C4-ELBAT	0.8 U	1.1	0.7 U	0.7 U	29%
	METHOD BLANK	0.7 U	1.1	0.6 U	0.7 U	29%
MATRIX SPIKE RECOVERIES: (232-12 sample spiked) (Spiked with 156 ppb)		NS	48%	35%	21%	19%
STANDARD REFERENCE MATERIAL:	PACS-1	11	535	543	116	29%
	CERTIFIED VALUES:	NC	1270 (±220)	1150(±180)	280 (±170)	

(1) Due to consistently low recoveries of the propyltin surrogate, it was discovered that this compound does not accurately reflect tributyltin recovery.
U indicates that the analyte was not detected above the detection limits shown.
NS indicates not spiked

SEDIMENT DATA (CF#232) 2/7/91
Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND
Sponsor: SKOGERBOE

SEDIMENT PAH DATA

(Concentrations in ug/kg Dry Weight)

Sponsor Code :	232-1	232-2	232-3	232-4	232-5	232-6	232-7	232-8	232-9	232-10
Battelle Code:	WR-PL-BAT	WR-LAB-BAT	WR-EL-BAT	WR-AC-BAT	WR-LE-BAT	RH-SR-BAT	RH-LAB-BAT	RH-EL-BAT	RH-LE-BAT	PS-C4-ACBAT
NAPHTHALENE	32.6 U	24.6 U	29.0 U	26.2 U	22.3 U	20.1 U	23.6 U	24.3 U	23.4 U	27.4 U
ACENAPHTHYLENE	4.9 U	10.1	29.0	9.7	16.2	3.1 U	4.3	3.9	5.2	4.2 U
ACENAPHTHENE	12.4 U	13.5	22.9	9.9 U	11.8	7.6 U	9.0 U	9.2 U	8.9 U	10.4 U
FLUORENE	9.9 U	14.4	30.7	9.9	13.9	6.1 U	7.8	9.7	16.0	8.3 U
PHENANTHRENE	133.0	263.0	603.0	184.0	265.0	39.2	57.6	69.3	82.6	12.9
ANTHRACENE	22.9	67.1	109.0	31.4	56.6	12.6	23.0	34.5	84.0	4.9 U
FLUORANTHENE	246.0	328.0	730.0	260.0	475.0	66.6	93.5	99.8	160.6	8.8
PYRENE	318.0	425.0	882.0	338.0	606.0	109.0	159.1	189.3	329.7	14.8
BENZ[A]ANTHRACENE	152.0	239.0	447.0	154.0	307.0	76.4	144.6	.120.8	237.6	14.1
CHRYSENE	112.0	161.0	280.0	92.5	206.0	64.0	101.1	152.6	317.6	4.9
BENZO (B,K)FLUORANTHENE *	469.0	503.0	791.0	343.0	806.0	328.0	625.1	603.0	1054.2	13.2
BENZO(A)PYRENE	332.0	357.0	670.0	301.0	671.0	168.0	292.4	293.1	491.0	6.3
INDENO[1,2,3 cd]PYRENE	201.0	244.0	421.0	210.0	507.0	93.3	148.7	184.6	305.4	6.6 U
DIBENZ[a,h]ANTHRACENE	4.5 U	41.1	88.2	30.1	80.7	24.1	34.7	35.1	71.7	3.8 U
BENZO[g,h,i]PERYLENE	324.0	389.0	663.0	353.0	754.0	147.4	221.3	203.8	346.0	10.9
SURROGATE RECOVERY:										
D10-FLUORENE	88%	86%	77%	74%	76%	62%	100%	95%	89%	41%
D10 ANTHRACENE	92%	70%	71%	93%	84%	63%	104%	100%	96%	80%
D10-PYRENE	78%	74%	81%	79%	75%	55%	83%	97%	95%	49%

U indicates analyte not detected at or above detection limit shown
* All benzofluoranthene isomers are quantified together

SEDIMENT DATA (CF#232) 2/7/91
Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND
Sponsor: SKOGERBOE

SEDIMENT PAH DATA

(Concentrations in ug/kg Dry Weight)

Sponsor Code:	232-11	232-12	232-13	232-14	
Battelle Code:	PS-C4-LABBAT	PS-C4-LEBAT	PS-C4-PLBAT	PS-C4-ELBAT	METHOD BLANK
NAPHTHALENE	20.3 U	24.5 U	21.6 U	23.5 U	1.5 U
ACENAPHTHYLENE	3.1 U	3.7 U	3.3 U	3.6 U	0.22 U
ACENAPHTHENE	7.7 U	9.3 U	8.2 U	8.9 U	0.56 U
FLUORENE	6.2 U	7.5 U	6.6 U	7.1 U	0.44 U
PHENANTHRENE	8.2 U	14.6	22.3	12.7	0.59 U
ANTHRACENE	3.6 U	4.4 U	3.8 U	4.2 U	0.26 U
FLUORANTHENE	7.1	10.8	21.3	6.0 U	0.37 U
PYRENE	9.3	14.2	24.9	5.8	0.28 U
BENZ[A]ANTHRACENE	8.4	16.8	25.8	5.5	0.26 U
CHRYSENE	3.7	6.0	10.8	3.6 U	0.22 U
BENZO (B,K)FLUORANTHENE *	9.8	14.7	21.8	5.6	0.28 U
BENZO[A]PYRENE	3.9	5.1	12.5	3.6 U	0.22 U
INDENO[1,2,3-cd]PYRENE	4.9 U	5.9 U	6.8	5.7 U	0.35 U
DIBENZ[a,h]ANTHRACENE	2.8 U	3.4 U	3.1 U	3.3 U	0.2 U
BENZO[g,h,i]PERYLENE	6.5	6.2	23.4	2.9 U	0.18 U
SURROGATE RECOVERY:					
D10-FLUORENE	64%	57%	87%	75%	93%
D10-ANTHRACENE	78%	66%	89%	90%	97%
D10-PYRENE	66%	64%	79%	80%	88%

U indicates analyte not detected at or above detection limit shown
* All benzofluoranthene isomers are quantified together

SEDIMENT DATA

Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND (CF#232) 7/31/91

Sponsor: SKOGERBOE

SEDIMENT PESTICIDE DATA

(Concentrations in ug/kg Dry Weight)

Battelle Code:	232-6	232-7	232-8	232-9	
Sponsor Code:	RH-SR-BAT	RH-LAB-BAT	RH-EL-BAT	RH-LE-BAT	METHOD BLANK
PESTICIDES					
ALDRIN	3 U	3.1 U	3.4 U	3.1 U	2 U
A-BHC	3 U	3.1 U	3.4 U	3.1 U	2 U
B-BHC	3 U	3.1 U	3.4 U	3.1 U	2 U
D-BHC	3 U	3.1 U	3.4 U	3.1 U	2 U
CHLORDANE	3 U	3.1 U	3.4 U	3.1 U	2 U
4,4'DDD	260 D	100 D	170	190 D	2 U
4,4'DDE	3 U	3.1 U	3.4 U	3.1 U	2 U
4,4'DDT	240 DB	170 DB	92 DB	240 DB	9.2
DIELDRIN	55	3.1 U	3.4 U	20 B	5.1
ENDOSULFAN I	3 U	3.1 U	3.4 U	3.1 U	2 U
ENDOSULFAN II	3 U	3.1 U	3.4 U	3.1 U	2 U
ENDOSULFAN SULFATE	3 U	3.1 U	3.4 U	3.1 U	2 U
ENDRIN	10 B	3.1 U	3.4 U	3.1 U	6.5
ENDRIN ALDEHYDE	5.2 B	3.1 U	3.4 U	3.1 U	13
HEPTACHLOR	3 U	3.1 U	3.4 U	3.1 U	2 U
HEPTACHLOR EPOXIDE	3 U	3.1 U	3.4 U	3.1 U	2 U
LINDANE (G BHC)	3 U	3.1 U	3.4 U	3.1 U	2 U
TOXAPHENE	30 U	31 U	34 U	31 U	2 U
METHOXYCHLOR	6.1 U	6.1 U	6.7 U	6.3 U	2 U
ENDRIN KETONE	5.4	3.1 U	3.4 U	3.1 U	2 U
SURROGATE RECOVERY (DBC):	92%	82%	107%	107%	84%

U indicates analyte not detected at or above detection limit shown

B indicates analyte detected in method blank associated with sample

D indicates a dilution was made

SEDIMENT DATA (CF#232) 7/31/91

Project: PINOLE SHOAL, WEST RICHMOND, RICHMOND

Sponsor: SKOGERBOE

SEDIMENT PESTICIDE QUALITY CONTROL DATA

Sample Spiked: RH-SR-BAT

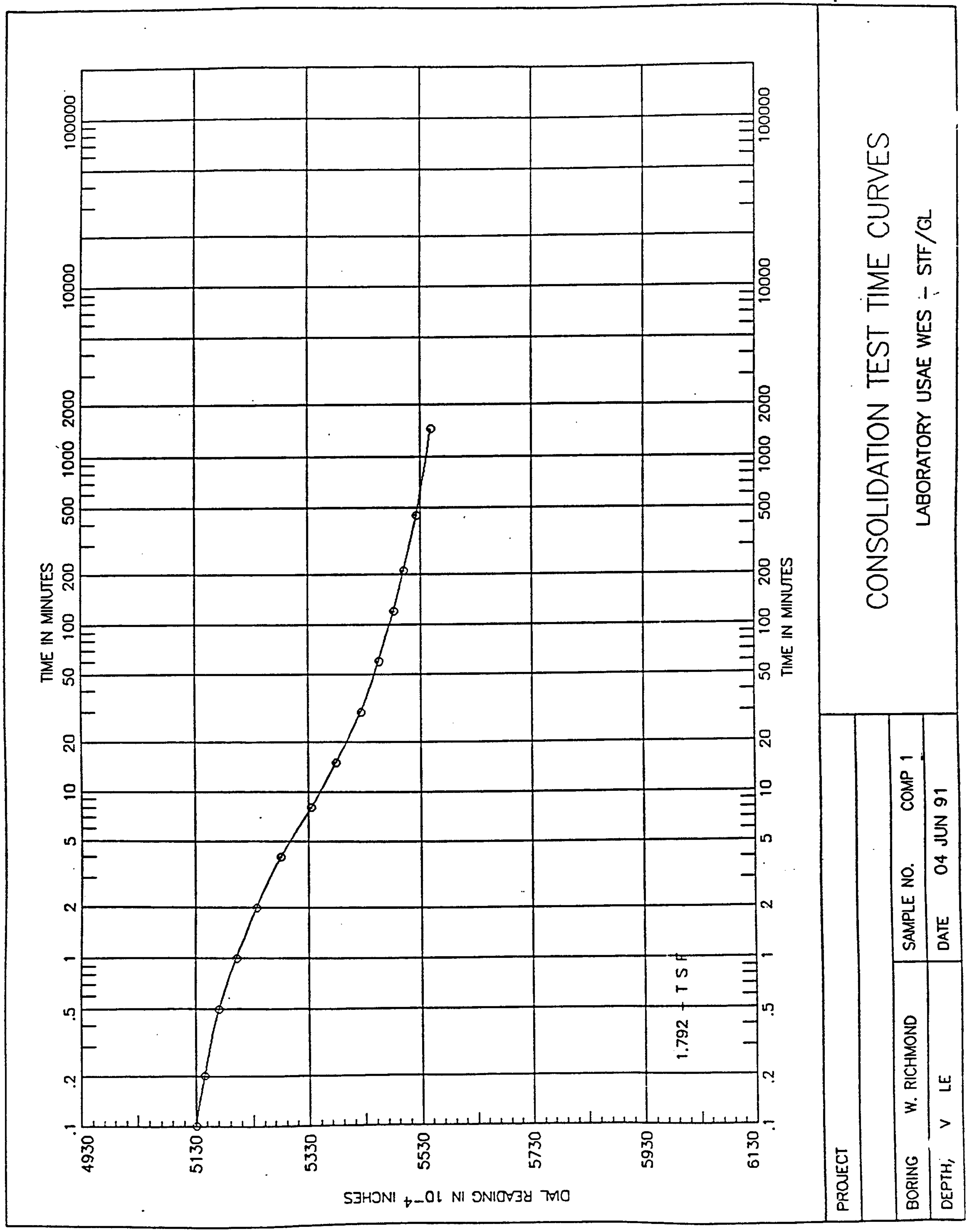
(Concentrations in ug/kg dry wt.)	MATRIX SPIKE			MATRIX SPIKE DUPLICATE			
PESTICIDES	Amount Spiked	Amount Recovered	Percent Recovered	Amount Spiked	Amount Recovered	Percent Recovered	QC Limits
ALDRIN	21.8	16.4	75%	20.7	13.6	66%	34-132
DIELDRIN	21.8	34	156% (A)	20.7	36	174% (A)	31-134
4,4'DDT	21.8	69	(A)	20.7	105	(A)	23-134
LINDANE (G-BHC)	21.8	14.3	66%	20.7	11.9	57%	46-127
ENDRIN	21.8	24	110%	20.7	30	145%	42-139
HEPTACHLOR	21.8	16.6	76%	20.7	13.5	65%	35-130
SURROGATE RECOVERY (DBC):			80%			69%	

(A) Compound percent recovery outside of control limits due to high native concentrations.

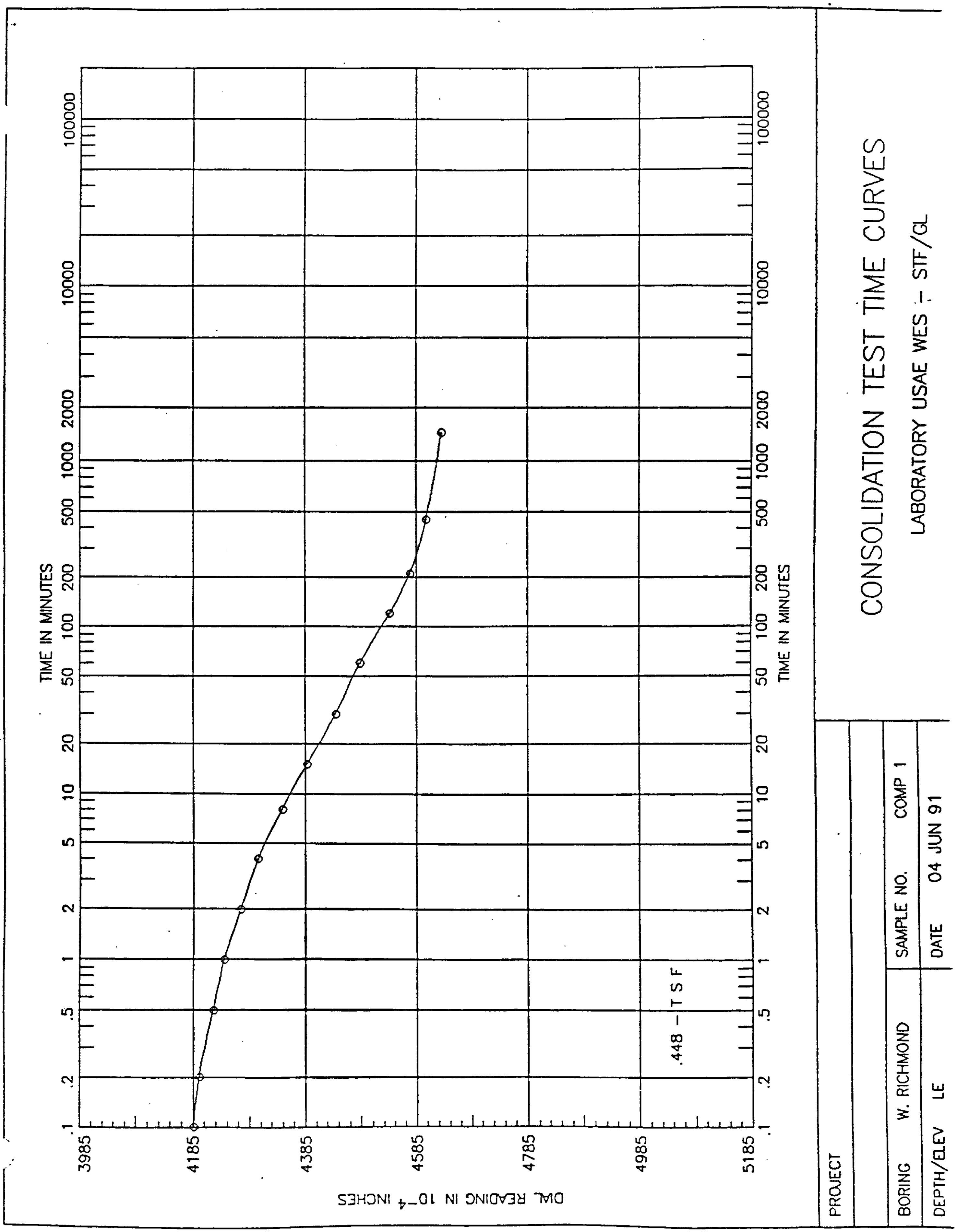
Appendix A3
Physical Characterization

a. Pinole Shoal Reach

b. West Richmond Reach



CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES - STF/GL
TIME IN MINUTES
.1 .2 .5 1 2 5 10 20 50 100 200 500 1000 2000 10000 100000
DIAL READING IN 10⁻⁴ INCHES
4930 5130 5330 5530 5730 5930 6130
1.792 - TSF
PROJECT
BORING
W. RICHMOND
SAMPLE NO.
COMP 1
DEPTH,
V LE
DATE
04 JUN 91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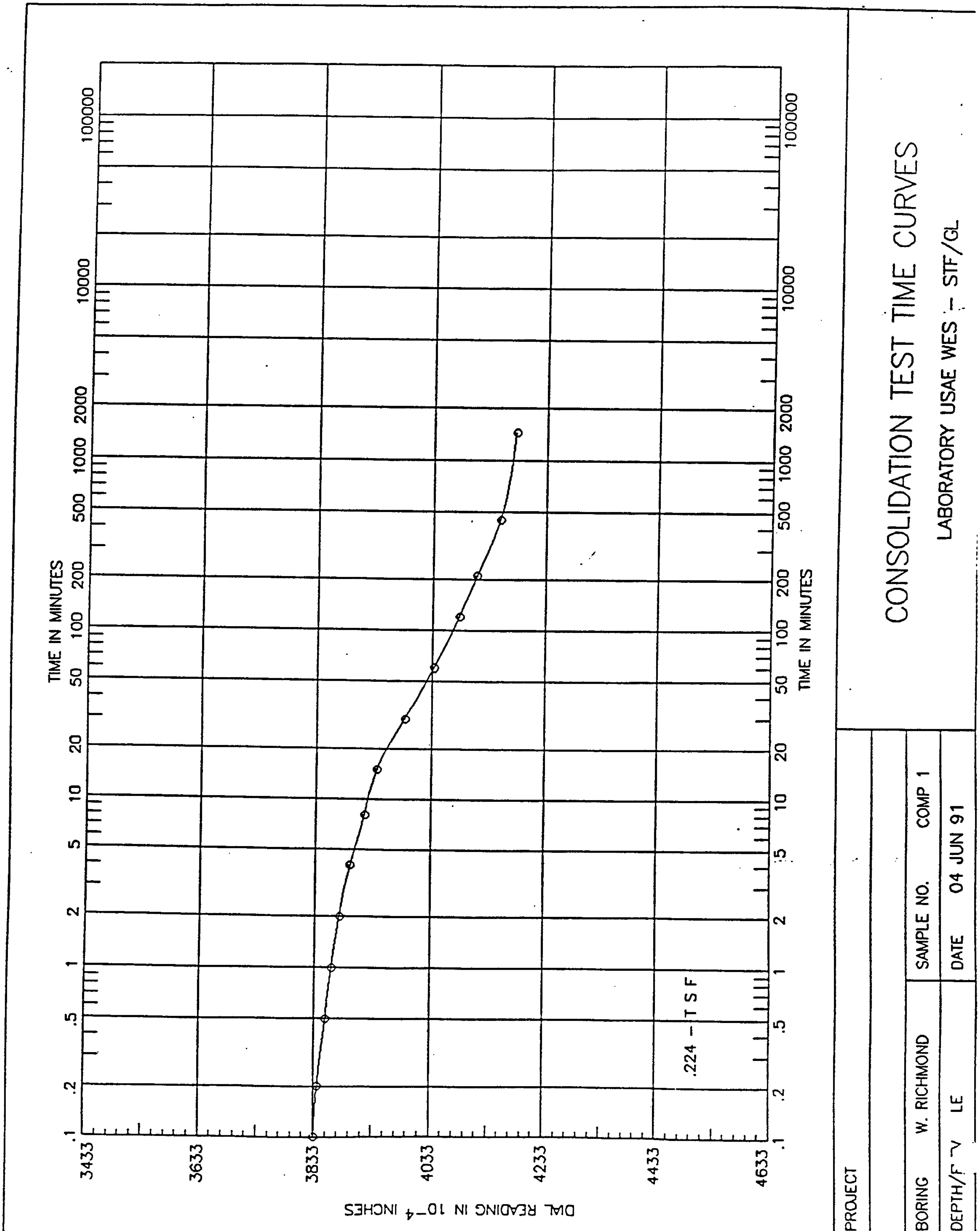
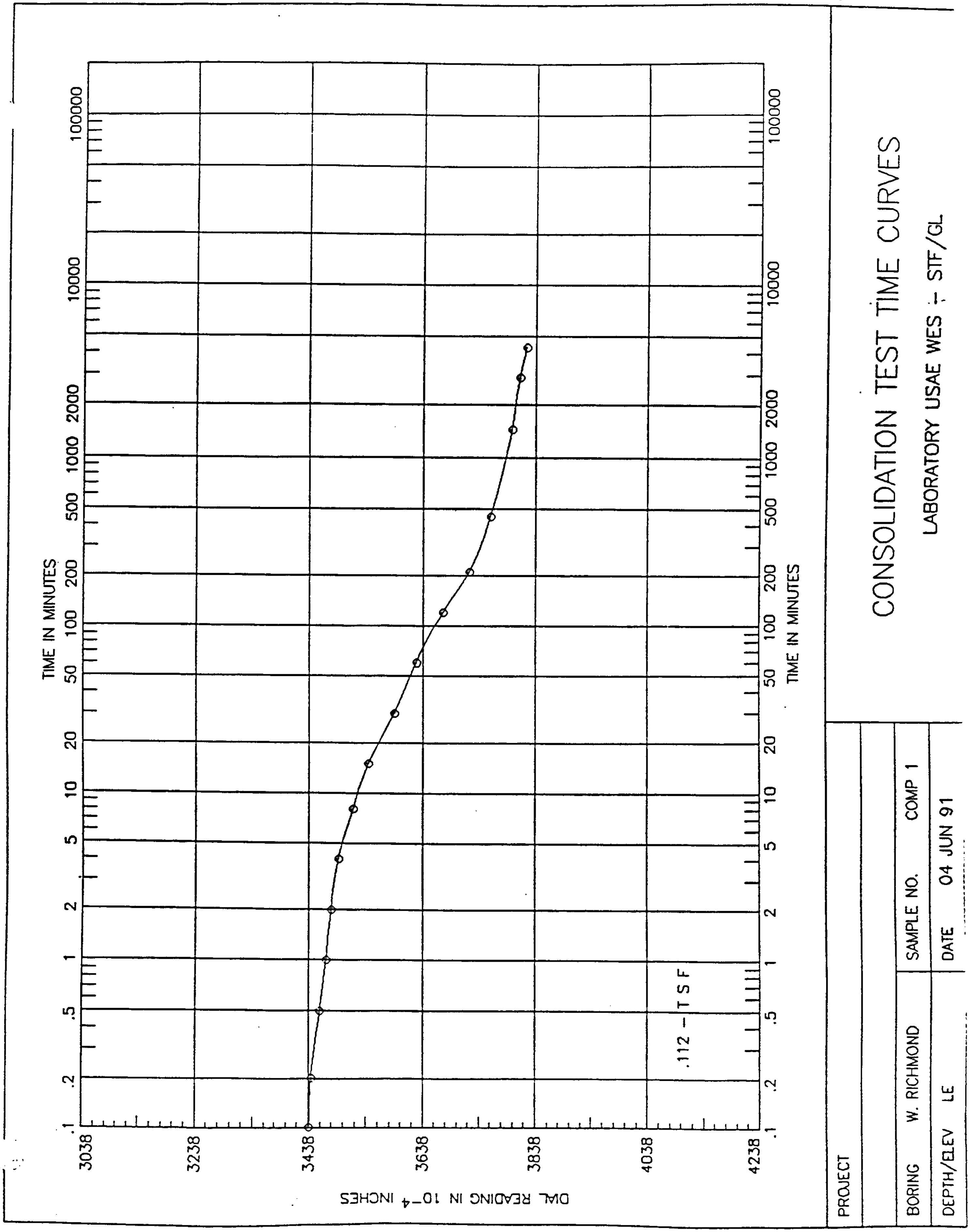
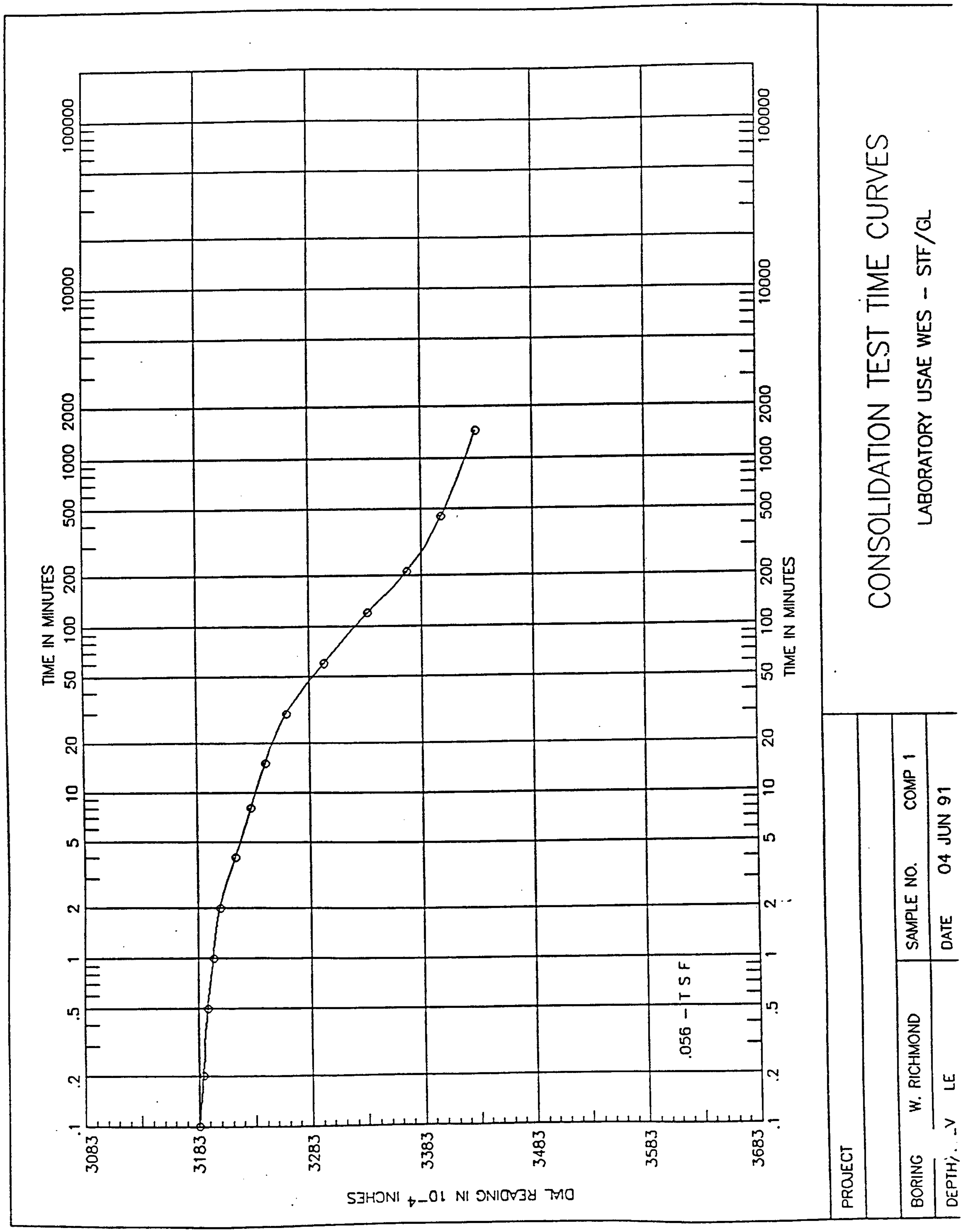
LABORATORY USAE WES -- STF/GL
TIME IN MINUTES
.1
.2
.5
1
2
5
10
20
50
100
200
500
1000
2000
10000
100000
DIAL READING IN 10^{-4} INCHES
3985
4185
4385
4585
4785
4985
5185
.448 — T S F
PROJECT
BORING
W. RICHMOND
SAMPLE NO.
COMP 1
DEPTH/ELEV
LE
DATE
04 JUN 91


CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES - STF/GL
TIME IN MINUTES
.1
.2
.5
1
2
5
10
20
50
100
200
500
1000
2000
10000
100000
DIAL READING IN 10⁻⁴ INCHES
3433
3633
3833
4033
4233
4433
4633
.224 - T S F
PROJECT
BORING
W. RICHMOND
SAMPLE NO.
COMP 1
DEPTH/F
LE
DATE
04 JUN 91


CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES -- STF/GL
TIME IN MINUTES
DIAL READING IN 10^{-4} INCHES
.112 — T S F
.1 .2 .5 1 2 5 10 20 50 100 200 500 1000 2000 10000 100000
3038 3238 3438 3638 3838 4038 4238
PROJECT
BORING W. RICHMOND
SAMPLE NO. COMP 1
DEPTH/ELEV LE
DATE 04 JUN 91


CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES -- STF/GL
TIME IN MINUTES
DIAL READING IN 10^-4 INCHES
.056 -- T S F
PROJECT
BORING
DEPTH/ELEV
SAMPLE NO. COMP 1
DATE 04 JUN 91
W. RICHMOND
LE
3083
3183
3283
3383
3483
3583
3683
.1
.2
.5
1
2
5
10
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50
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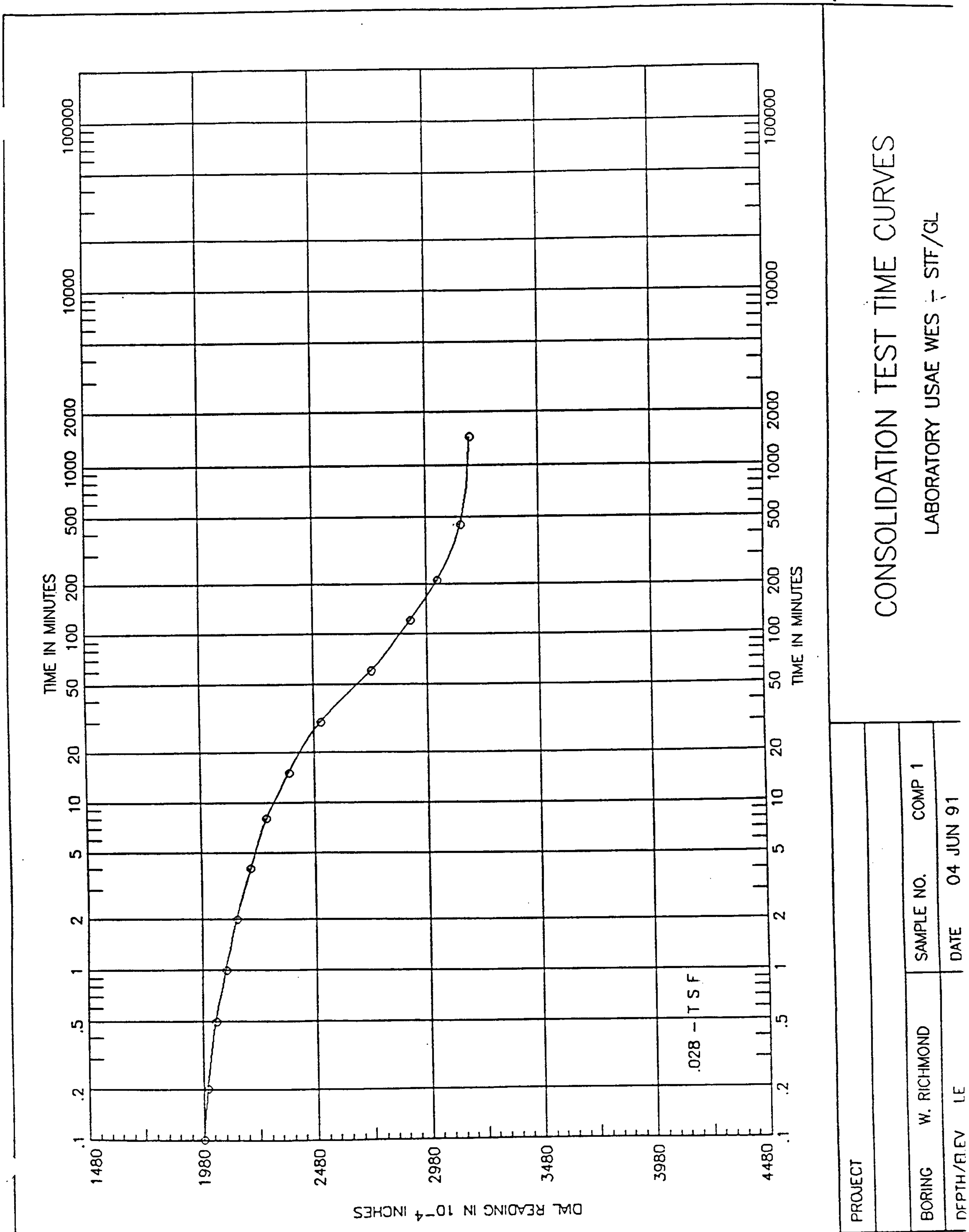
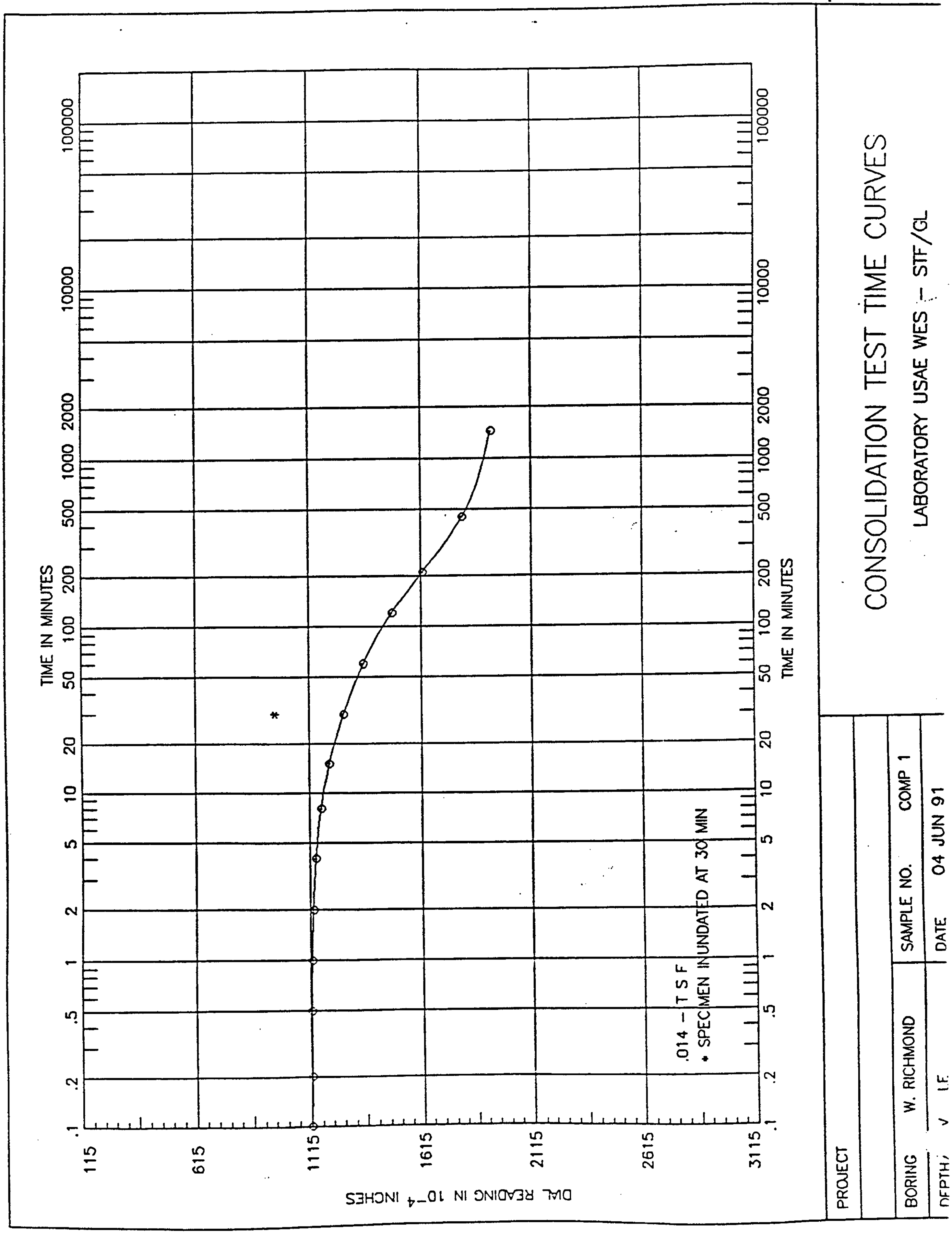
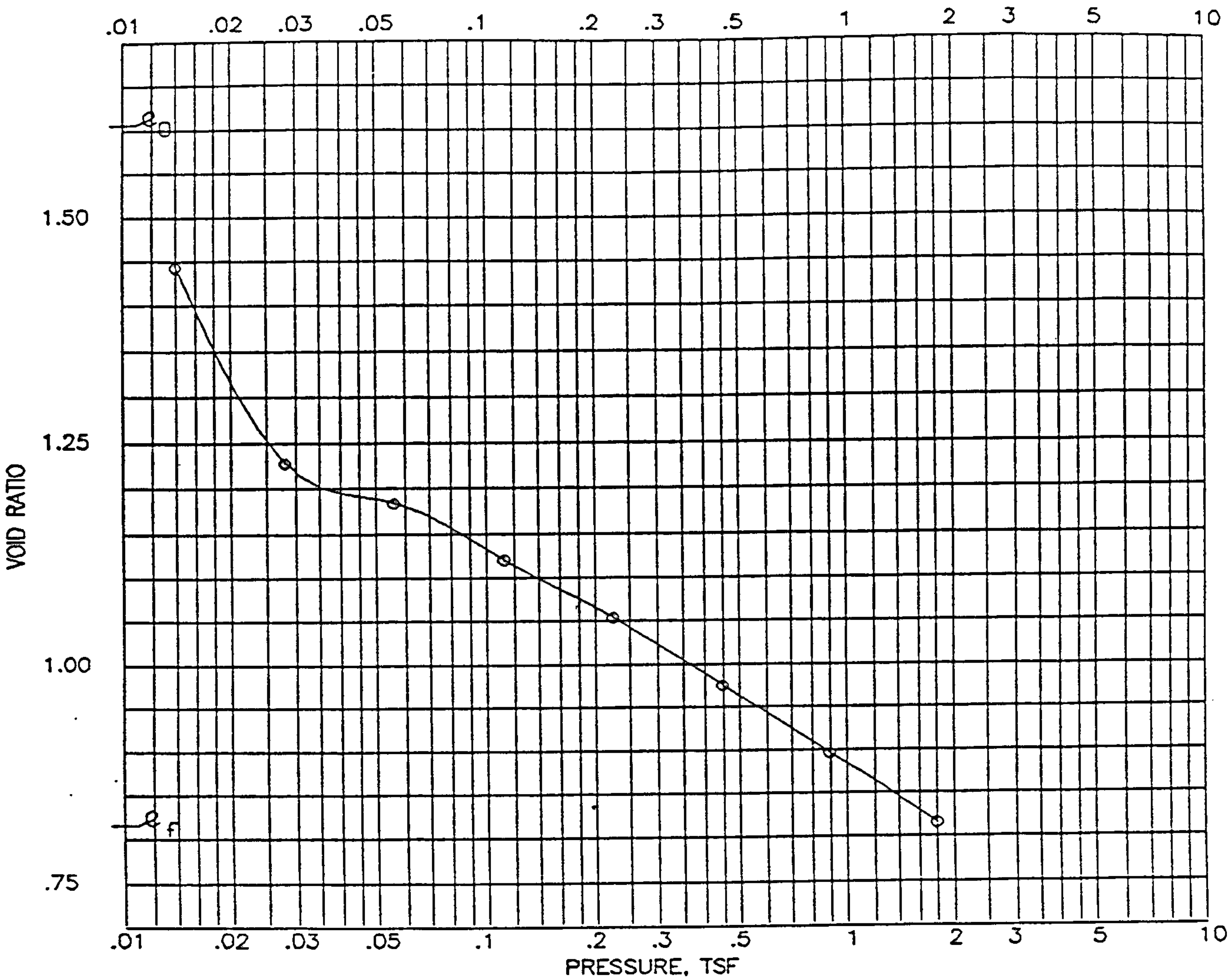
200
500
1000
2000
10000
100000


CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES - STF/GL
TIME IN MINUTES
DIAL READING IN 10^-4 INCHES
.028 - T S F
PROJECT
BORING W. RICHMOND
SAMPLE NO. COMP 1
DEPTH/ELEV LE
DATE 04 JUN 91

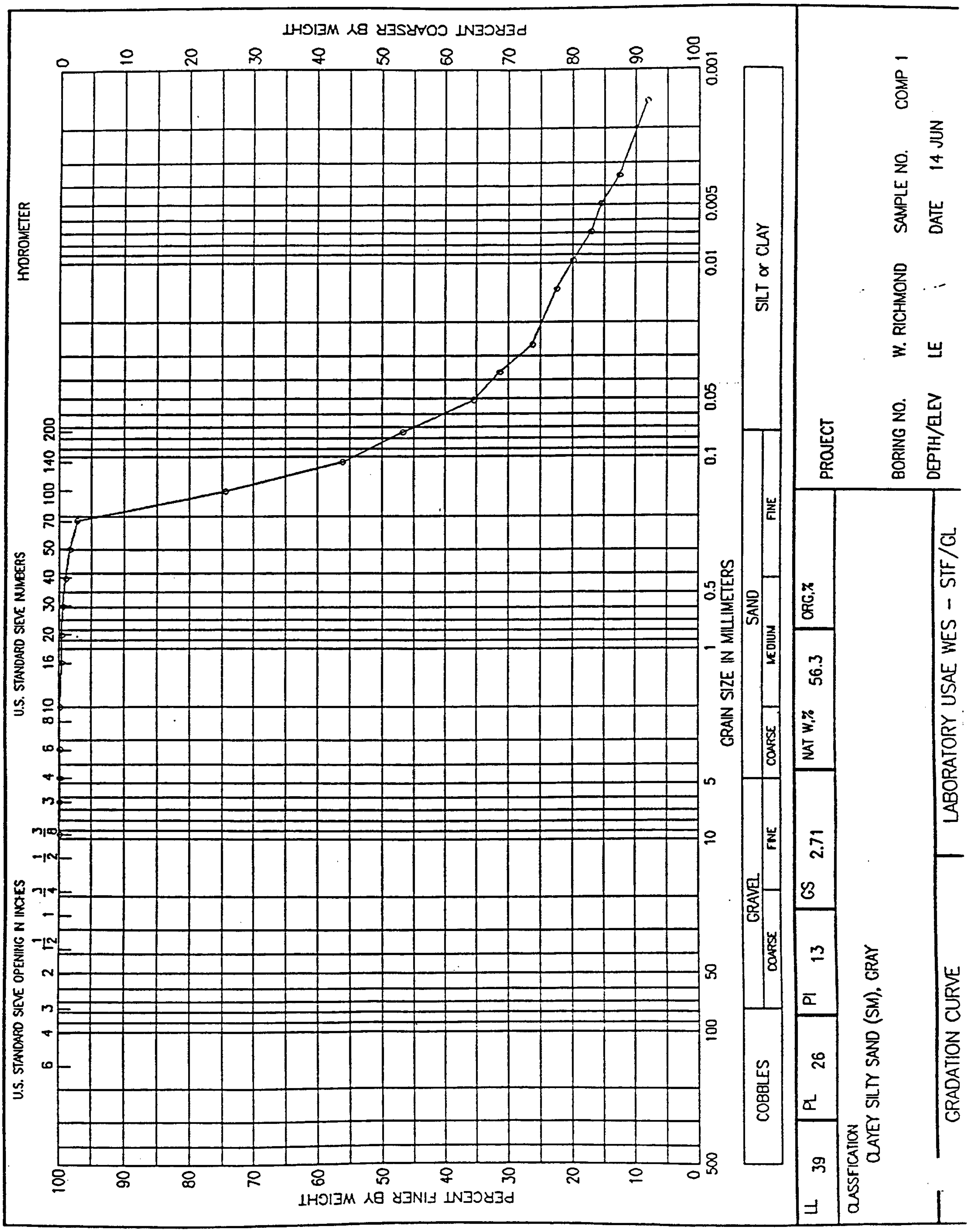


CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES - STF/GL
TIME IN MINUTES
.1 .2 .5 1 2 5 10 20 50 100 200 500 1000 2000 10000 100000
DIAL READING IN 10-4 INCHES
115 615 1115 1615 2115 2615 3115
.014 - T S F
* SPECIMEN INUNDATED AT 30 MIN
PROJECT
BORING W. RICHMOND
SAMPLE NO. COMP 1
DEPTH I.F.
DATE 04 JUN 91

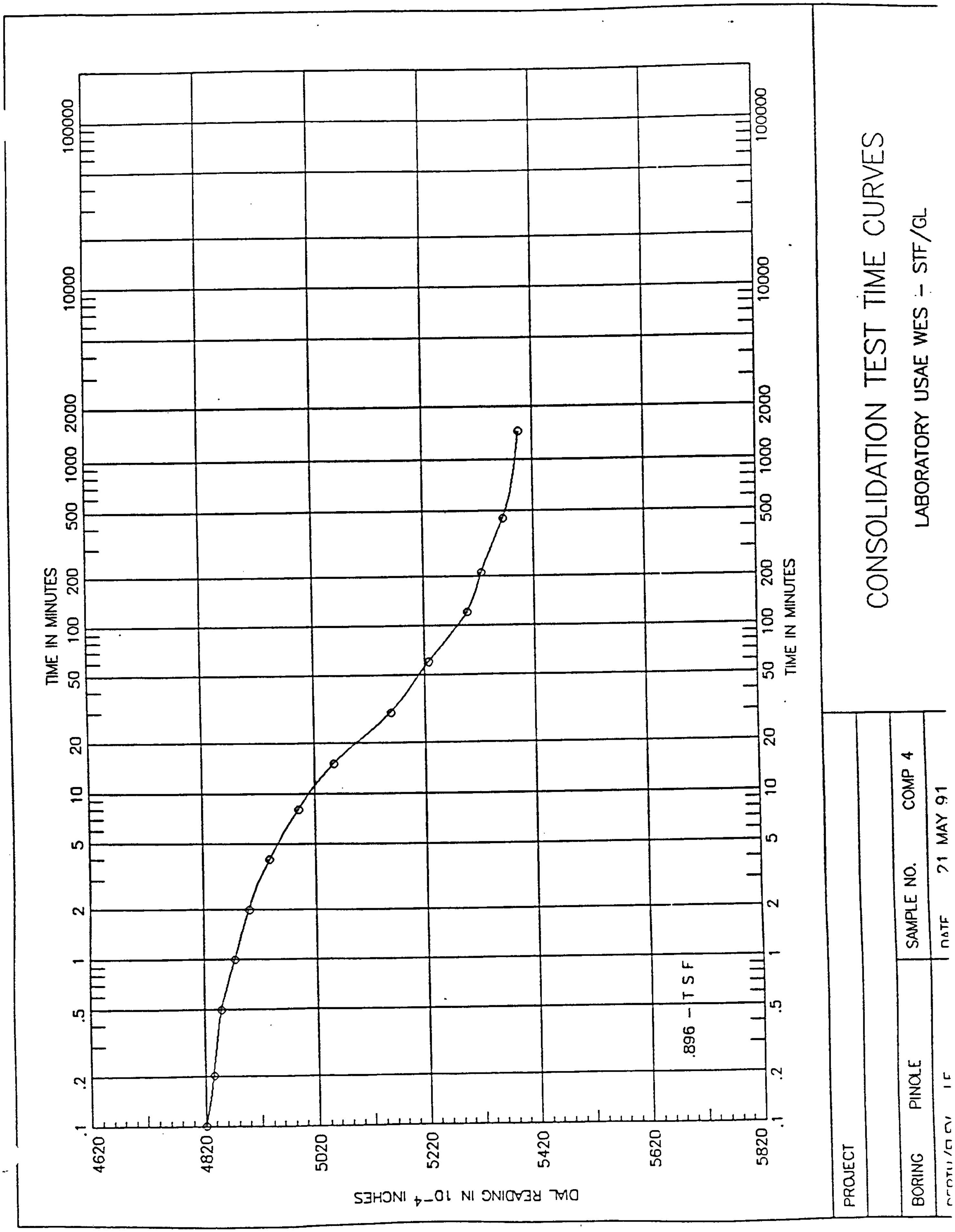


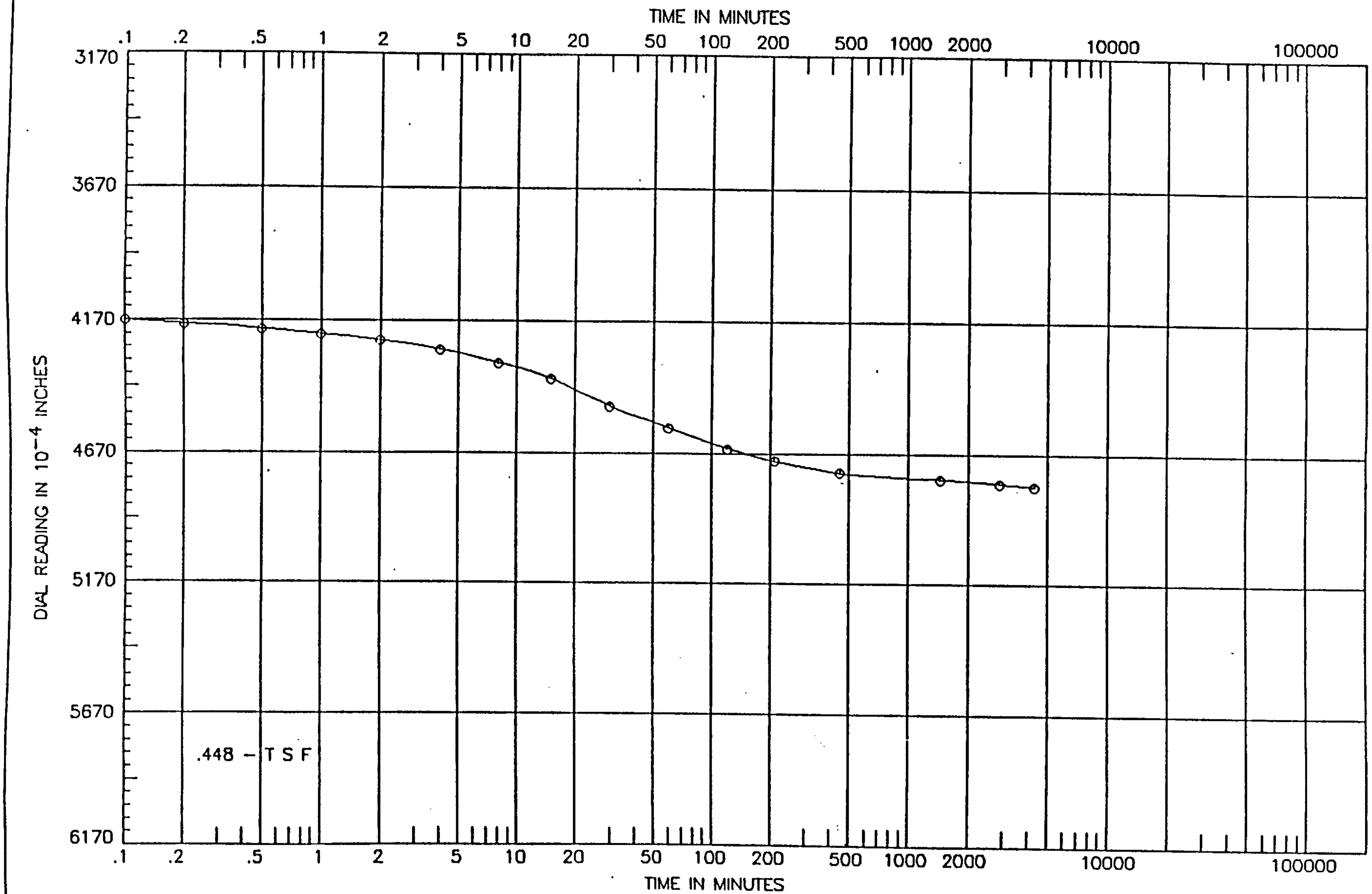
				BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF			WATER CONTENT, %	59.2	31.6
PRECONSOL. PRESSURE, TSF			DRY DENSITY, PCF	65.0	93.2
COMPRESSION INDEX			SATURATION, %	100 +	100 +
TYPE SPECIMEN			VOID RATIO	1.604	.815
DIA. IN 2.50	HT. IN 1.500		BACK PRESSURE, TSF		
CLASSIFICATION	CLAYEY SILTY SAND (SM), GRAY				
LL 39	PL 26	PI 13	PROJECT		
GS 2.71	D_{10}				
REMARKS:			BORING NO. W. RICHMOND	SAMPLE NO. COMP 1	
			DEPTH/ELEV LE	TECH. JAL	
			LABORATORY USAE WES – STF/GL	DATE 04 JUN 91	
			CONSOLIDATION TEST REPORT		

SHEET 1 OF 9



U.S. STANDARD SIEVE OPENING IN INCHES
U.S. STANDARD SIEVE NUMBERS
HYDROMETER
6 4 3 2 1 1/2 1 3/4 1/2 3/8 3 4 6 8 10 16 20 30 40 50 70 100 140 200
PERCENT FINER BY WEIGHT
100 90 80 70 60 50 40 30 20 10 0
PERCENT COARSER BY WEIGHT
0 10 20 30 40 50 60 70 80 90 100
500 100 50 10 5 1 0.5 0.1 0.05 0.01 0.005 0.001
GRAIN SIZE IN MILLIMETERS
COBBLES
GRAVEL
COARSE
FINE
SAND
COARSE
MEDIUM
FINE
SILT or CLAY
LL 39
PL 26
PI 13
GS 2.71
NAT W,% 56.3
ORG,%
CLASSIFICATION
CLAYEY SILTY SAND (SM), GRAY
PROJECT
BORING NO. W. RICHMOND
SAMPLE NO. COMP 1
DEPTH/ELEV LE
DATE 14 JUN
GRADATION CURVE
LABORATORY USAE WES - STF/GL

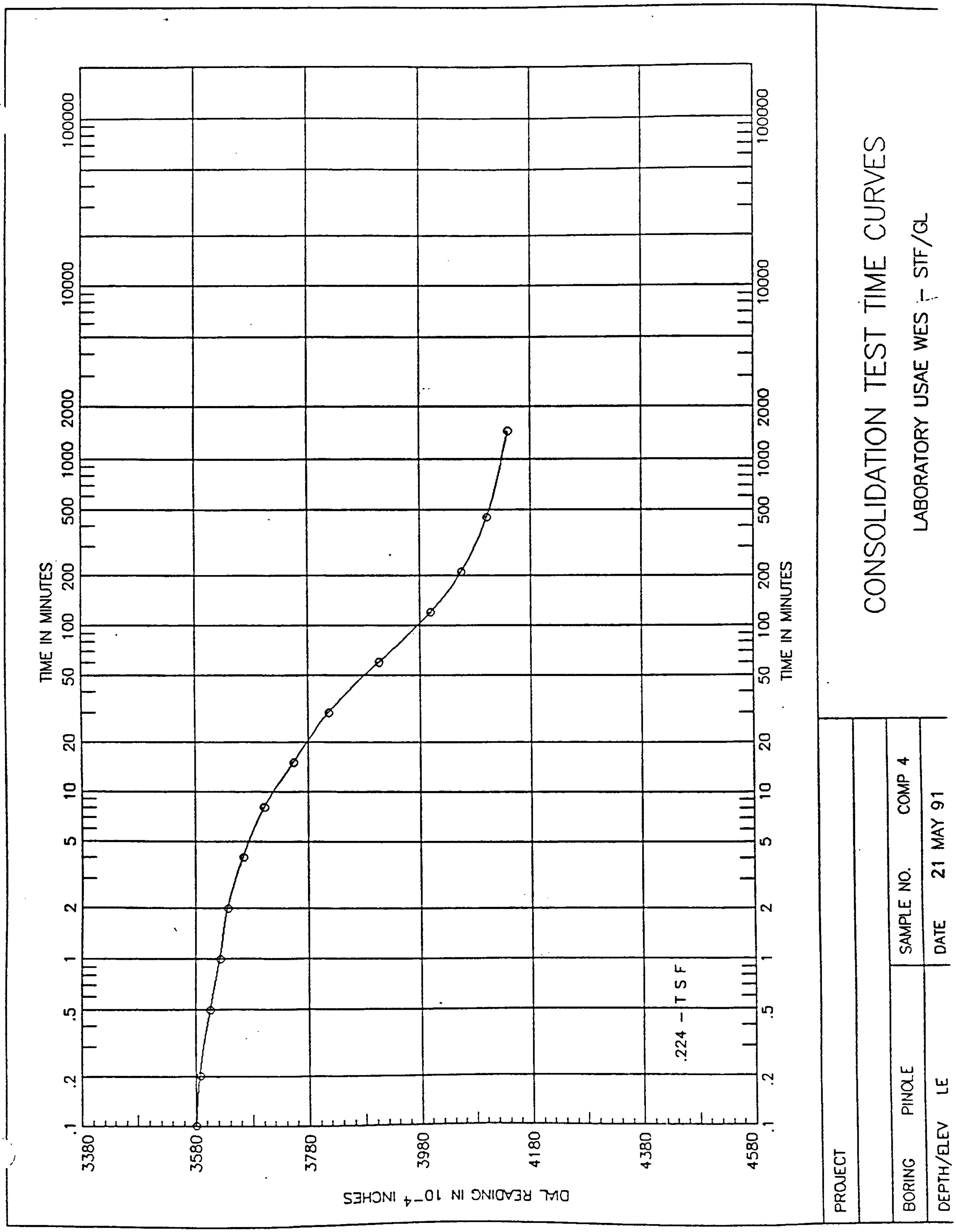

CONSOLIDATION TEST TIME CURVES
LABORATORY USAE WES - STF/GL
TIME IN MINUTES
DIAL READING IN 10^-4 INCHES
.896 - T S F
PROJECT
BORING PINOLE
SAMPLE NO. COMP 4
DATE 21 MAY 91



PROJECT	
BORING PINOLE	SAMPLE NO. COMP 4
DEPTH/ / LE	DATE 21 MAY 91

CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL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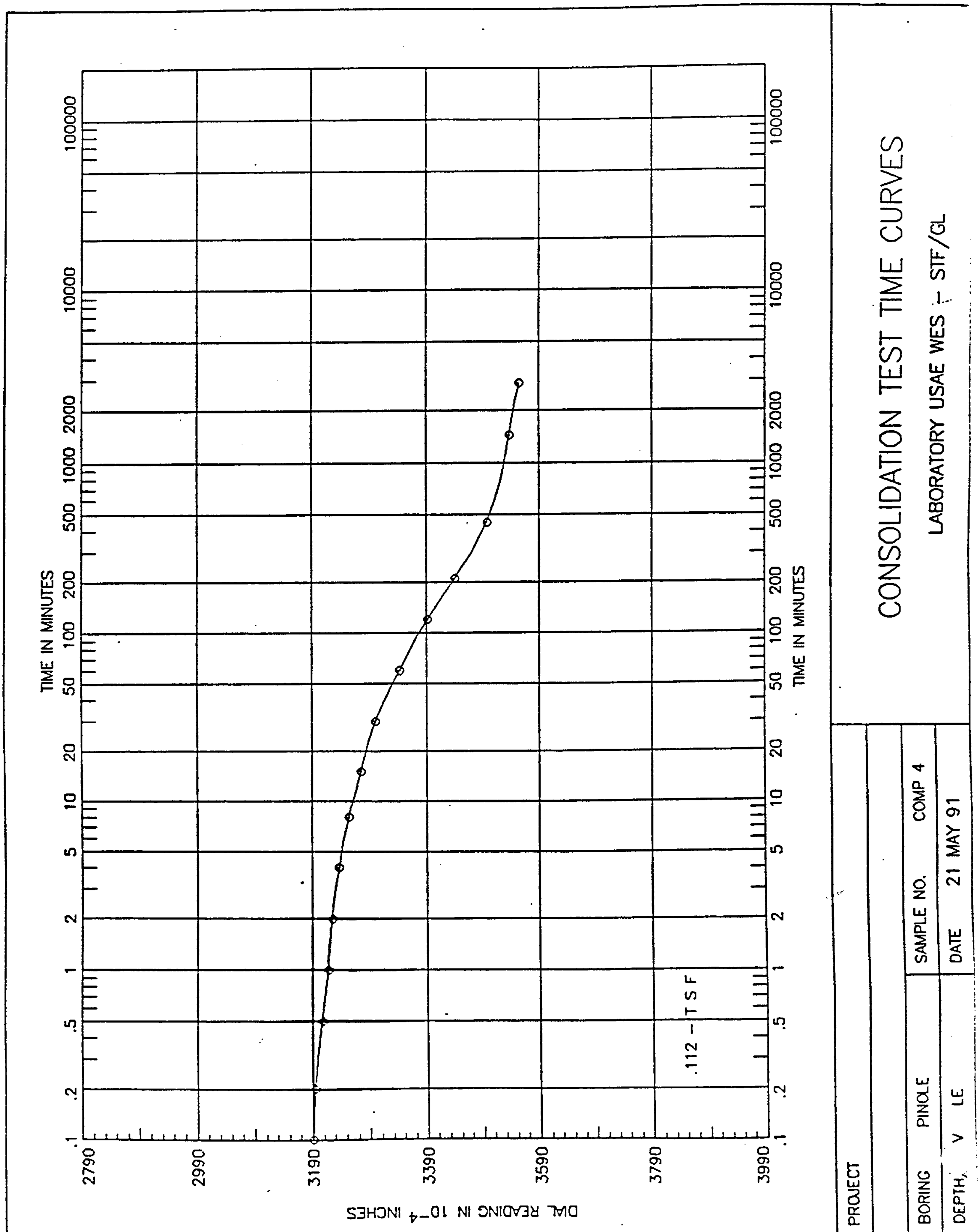
TIME IN MINUTES
DIAL READING IN 10⁻⁴ INCHES
.224 — T S F
PROJECT
BORING PINOLE
SAMPLE NO. COMP 4
DEPTH/ELEV LE
DATE 21 MAY 91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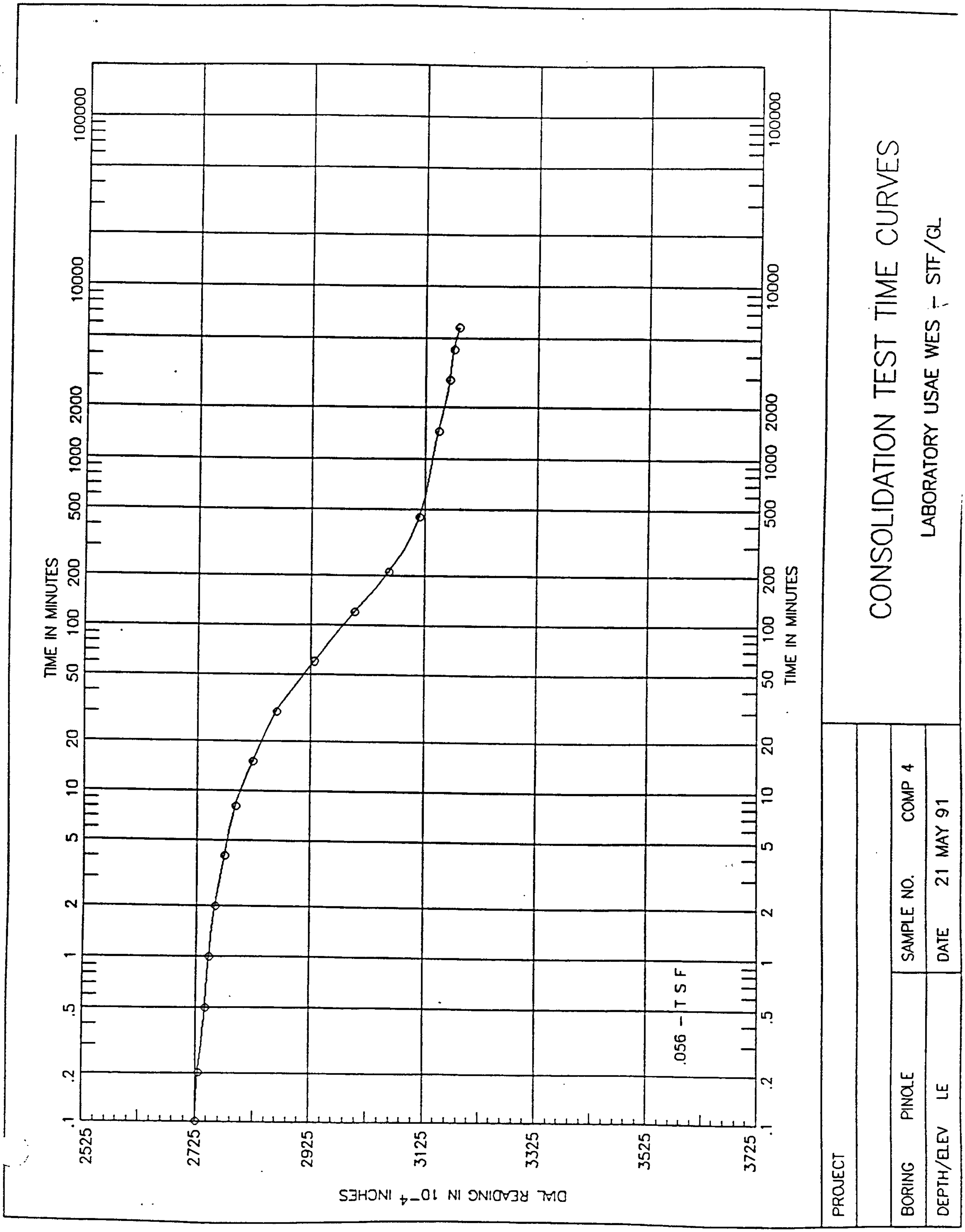
SAMPLE NO. COMP 4
DEPTH V LE
DATE 21 MAY 91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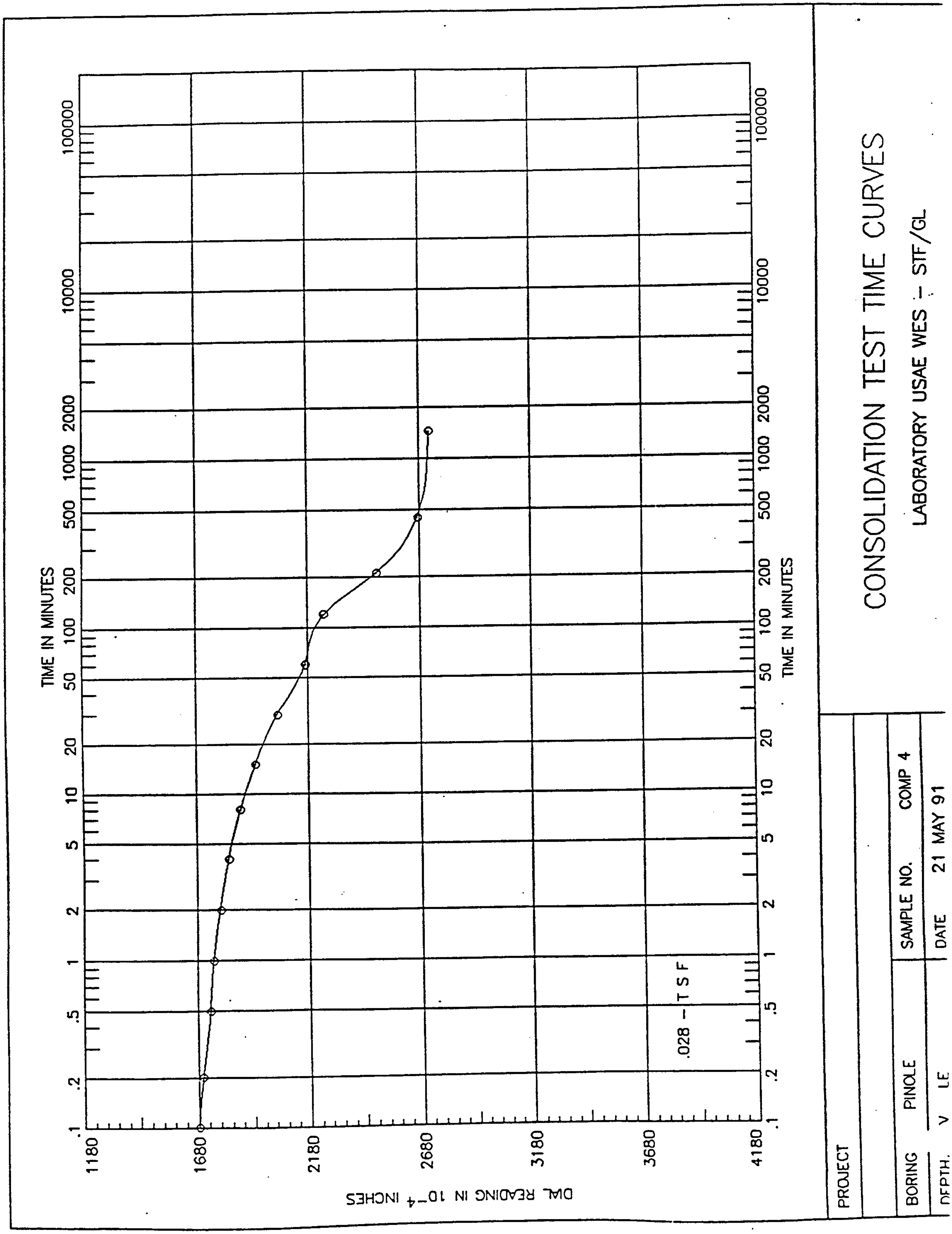
BORING PINOLE
SAMPLE NO. COMP 4
DEPTH/ELEV LE
DATE 21 MAY 91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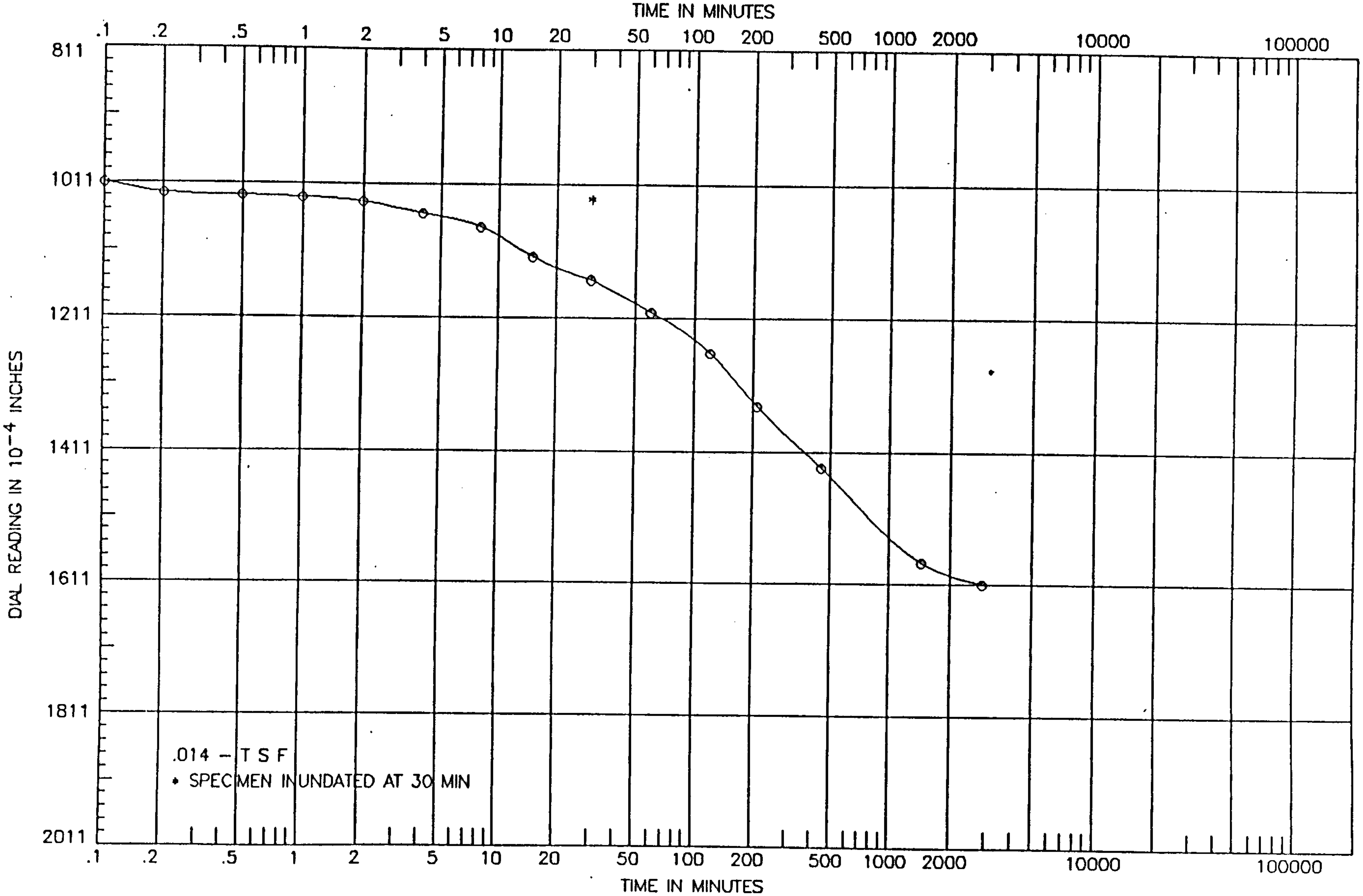
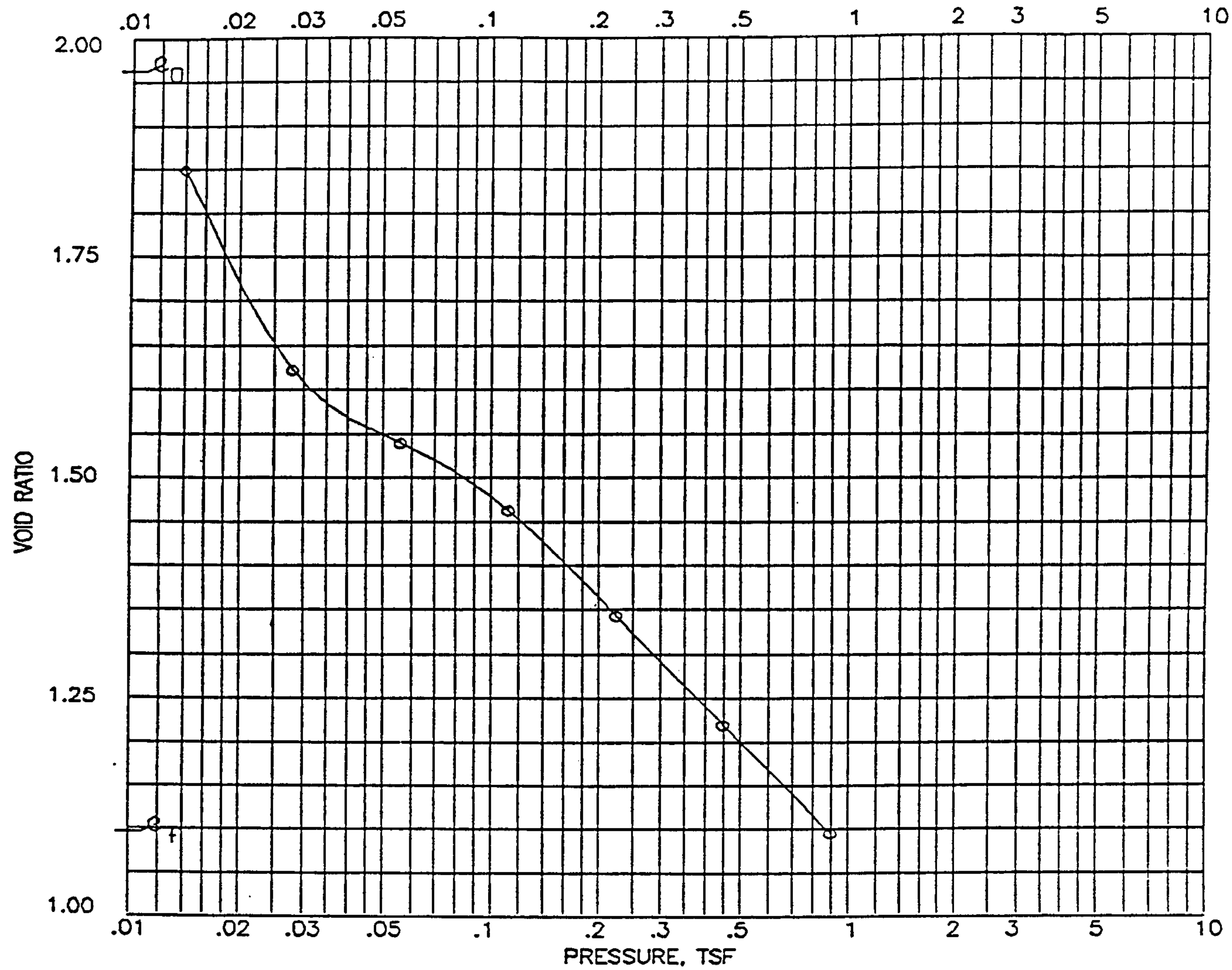
PROJECT
BORING PINOLE
SAMPLE NO. COMP 4
DEPTH. V LE
DATE 21 MAY 91



PROJECT	
BORING PINOLE	SAMPLE NO. COMP 4
DEPTH/ELEV LE	DATE 21 MAY 91

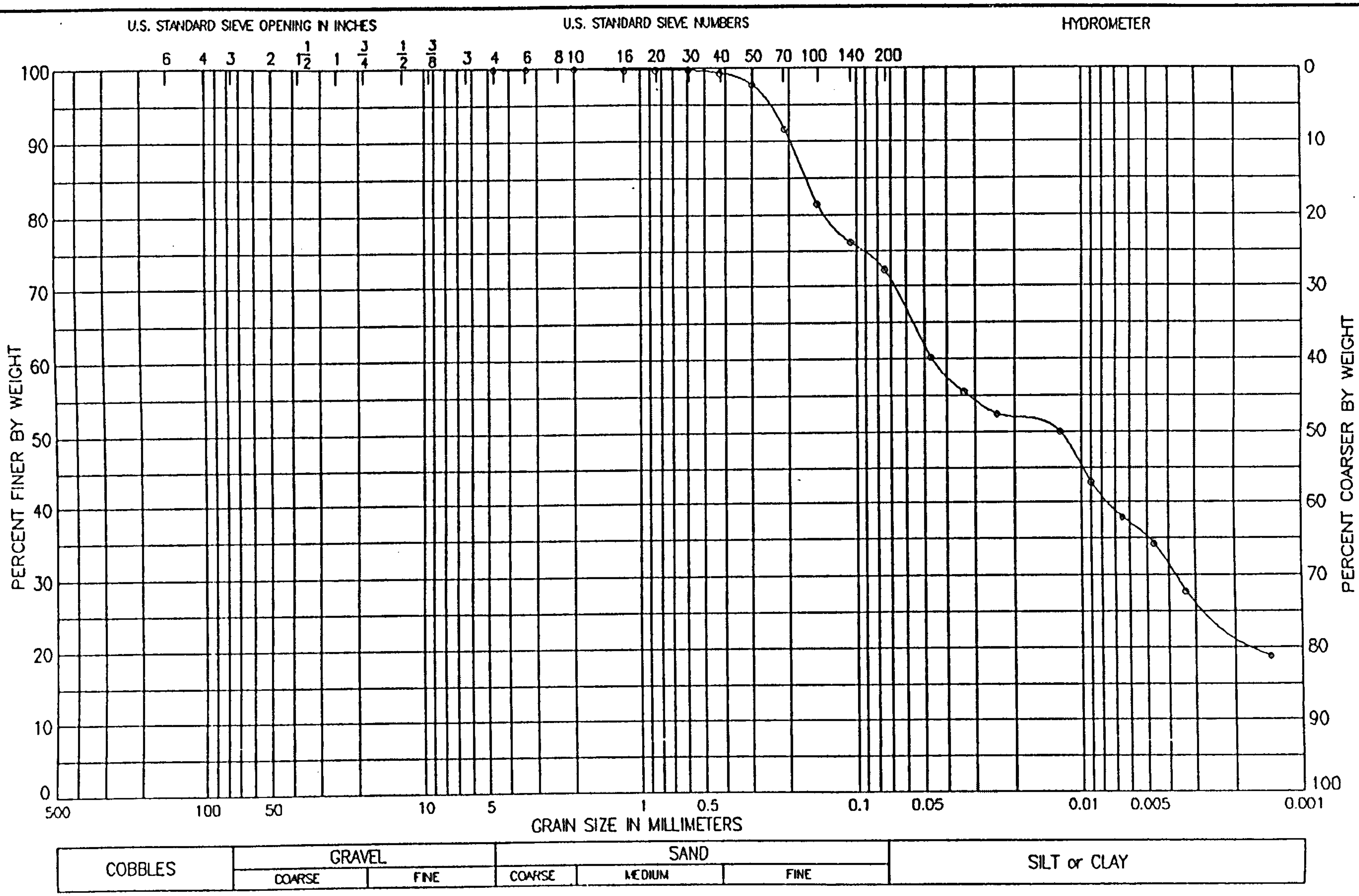
CONSOLIDATION TEST TIME CURVES

LABORATORY USAE WES – STF/GL



			BEFORE TEST	AFTER TEST
OVERBURDEN PRESSURE, TSF		WATER CONTENT, %	71.6	42.0
PRECONSOL. PRESSURE, TSF		DRY DENSITY, PCF	57.8	81.7
COMPRESSION INDEX		SATURATION, %	99.9	100 +
TYPE SPECIMEN		VOID RATIO	1.962	1.094
DIA. IN 2.50	HT. IN 1.500	BACK PRESSURE, TSF		
CLASSIFICATION	SANDY CLAY (CH), GRAY			
LL 53 / PL 24 / PI 29		PROJECT		
GS 2.74	D_{10}			
REMARKS:		BORING NO. PINOLE	SAMPLE NO. COMP 4	
		DEPTH/ELEV LE	TECH. JAL	
		LABORATORY USAE WES – STF/GL	DATE 21 MAY 91	
		CONSOLIDATION TEST REPORT		

SHEET 1 OF 8



LL 53	PL 24	PI 29	GS 2.74	NAT W,% 70.0	ORG,%

CLASSIFICATION
SANDY CLAY (CH), GRAY

PROJECT

BORING NO. PINOLE SAMPLE NO. COMP 4
DEPTH/ELEV LE DATE 14 JUN 91

GRADATION CURVE | LABORATORY USAF WES – STE/CL

Appendix B
Field Survey

SUMMARY

There is an increased public awareness of the importance of wetlands and a heightened interest in restoration and creation of wetlands using dredged material. Dredged material is being tested for potential use in wetland creation and restoration projects. In order to evaluate the acceptability of wetland creation and restoration with dredged material, establishment of some form of reference wetland baseline from which to make informed evaluations is often necessary. Test data must be interpreted in relationship to realistic circumstances. The reference baseline is usually chosen from the particular location where wetlands will be created or restored.

The objective of this study was to determine the concentrations of contaminants in sediments, plants and animals in existing wetlands near proposed wetland creation sites and to establish a reference wetland baseline for the San Francisco Bay area. The data collected would become an initial wetland baseline that can be used to interpret and put perspective on results of wetland testing of dredged material from the San Francisco Bay area.

Thirteen naturally occurring wetlands were sampled in marine, estuarine and freshwater locations along San Francisco and Suisun Bays and in the Sacramento River Basin. Wetland sediment, plant and animal samples were collected and transported to the U.S. Army Engineer Waterways Experiment Station (WES) for processing and analysis. Samples were analyzed for metals, butyltins, petroleum aromatic hydrocarbons, pesticides and polychlorinated biphenyls.

The naturally-occurring wetlands in the San Francisco Bay area and the adjacent estuarine and freshwater areas contained relatively low levels of most metal, PCBs, PAHs, butyltin, and pesticide contaminants in soil/sediment, plants, and animals. Metals such as lead, chromium and arsenic appeared to have elevated concentrations in some plants and animals. There was a very depauperate faunal component in all the naturally-occurring wetlands surveyed, that may be the result of a more subtle impact. This survey was conducted toward the end of a five year drought in the region. This climatic condition no doubt influenced the existing fauna available for sampling.

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LIST OF TABLES

PREFACE

This report presents the results of a field survey of existing wetlands in the San Francisco Bay area performed for Messrs. Brian Walls, Duke Roberts, Mark Dettle and Tom Kendall, project managers at the San Francisco District of the US Army Corps of Engineers. The study was conducted by the US Army Engineer Waterways Experiment Station (WES) during the period July 1990 through September 1991.

Work was performed by Dr. Charles R. Lee, Soil Scientist; Dr. Henry E. Tatem, Zoologist; Dr. John W. Simmers, Research Biologist; Mr. Richard A. Price, Research Agronomist; Mr. Dennis L. Brandon, Statistician; Contaminant Mobility and Regulatory Criteria Group (CMRCG), Environmental Processes and Effects Division (EPED), Environmental Laboratory (EL); and Mr. Scott P. Miner, Ecologist, San Francisco District, U.S. Army Corps of Engineers (SPN).

Animal bioassessment acknowledges Mr. Lawrence Bird (ASCI Corporation), and Ms. Heather Holifield, Mr. Michael Pendarvis, and Mr. Johnny McGuffie (University Contract Students) for conducting the laboratory portion of this study. Plant bioassessment acknowledges Ms. Erika Seals and Ms. Elizabeth Tominey (University Contract Students) for laboratory processing and analysis of sediment and plant tissue. Heavy metals analyses of samples from the plant bioassay were provided by the Analytical Laboratory Group, Environmental Engineering Division, USAE-WES, Vicksburg, Mississippi. All other chemical analyses of sediment, water, and tissues were performed by Dr. Eric Crecelius, Battelle/Marine Sciences Laboratory, Sequim, WA.

At the time of the study, work was conducted under the supervision of Dr. Bobby L. Folsom, Jr., Chief, CMRCG; Mr. Donald L. Robey, Chief, EPED; Dr. John Harrison, Chief, EL, and Mr. Roderick A. Chisholm II, Chief, Environmental Branch, SPN.

At the time of the study, COL Larry Fulton, EN, was Commander and Director during the preparation of this report. Technical Director was Dr. Robert W. Whalin.

This report should be cited as follows:

Lee, C.R., Brandon, D.L., Simmers, J.W., Tatem, H.E., Price, R.A., and Miner, S.P. (2000). "Field Survey of Contaminant Concentrations in Existing Wetlands in the San Francisco Bay Area," ERDC/EL SR-00-15, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

I. INTRODUCTION

Background

Each year the Corps of Engineers dredges sediment from harbors and channels throughout the San Francisco Bay Area to maintain navigation and commerce. Productive use of dredged material to restore and create wetlands has gained more interest in recent years. Suitable dredged material has been used productively in over 120 locations across the U. S. (US Army EM-1110-2-5026). The importance of wetlands to the productivity of estuaries has been realized even more recently in the San Francisco Bay Area. A heightened public interest has emerged to restore wetland acreage that has dwindled away over the past 50 years. Consequently, there has been increased public desire to create and restore wetlands in the San Francisco Bay area in recent years. Dredged material was thought to be of potential value in wetland creation or restoration.

Purpose and Scope

The purpose of this report is to describe the results of a field survey of existing wetland sites in the San Francisco Bay Area and to establish a wetland baseline data set.

Objectives

The objectives of the survey were:

1) to identify relatively undisturbed wetlands typical of the San Francisco Bay area;

2) to collect samples of the dominant plants, animals (where present) and wetland soil from selected marine and estuarine wetlands in the vicinity of San Francisco Bay;

3) to analyze each plant tissue, animal tissue, and soil sample for the presence of contaminants, including toxic heavy metals, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and butyltin compounds such as Tributyltin (TBT);

4) to document the location and appearance of each of the sampling sites for future reference by map location and through aerial photographs.

II. FIELD SURVEY

Approach

The interpretation of the results of biological and chemical testing of a sediment to evaluate its potential use in wetland creation requires a yardstick (i.e. reference database) for comparison. For this reason, naturally-occurring wetlands in the San Francisco Bay area were identified and the soil/sediment and the indigenous plant and animal communities were sampled. In coordination with personnel of the USACE San Francisco District, sites were selected that are considered to be typical undisturbed wetlands by the District and the Federal and State resource agencies. Unfortunately, since settlement, the San Francisco Bay Area has been the source of anthropomorphic disturbance that has resulted in both modification of the pre-settlement landscape and the introduction of numerous plant and animal species. As a result, it is not always possible to locate the desired species or a sufficient biomass of the desired species for analysis. During the summer of 1990, when the field survey was conducted, animal species, live populations of bivalve mollusks in particular, were not present in either the marine or estuarine wetlands. The paucity of animals has certainly limited the comparative value of the following survey, however, the plant and sediment/soil collections do provide a suitable data base for the establishment of a baseline for wetlands in the San Francisco Bay Area comparison with the species employed in the mesocosm test procedures.

Methods and Materials

Site Selection. The initial selection of the wetlands to be considered was provided by the USACE San Francisco District personnel and consisted of wetlands selected within known wetland refuges and locations generally thought to have been little affected by anthropomorphic activities during recent years, or as in the case of Site 8, the disturbance was well documented and the site was of

interest to the District.

The potential sites were surveyed from the air and if there were no obvious reasons to reject the site, such as proximity to industrial activity, a location within the site was selected for the field sampling (Figure II-1). On several occasions if the helicopter employed by the field collection personnel was not able to land, if the field crew was not able to reach a suitable plant community due to dense vegetation once landed, or if the appropriate plant species were not present, the collection site was relocated as required.

Plant and Animal Identification. Plants and animals collected were identified using appropriate resource materials and reports such as Fernald (1950), Josselyn (1983), and Gosner (1979). Where appropriate, local botanists were consulted to confirm the plant identifications in the field.

Field Collection Technique. Locations of field collections, water salinity, and plant and animal species collected are given in Table II-1. In the marine wetland areas *Spartina foliosa* and *Salicornia subterminalis* were the predominate species. *Spartina* was collected from the low marsh (nearest the water) and *Salicornia* was collected from the high marsh (the zone inland from the *Spartina*). In general, two samples of *Spartina* labeled A and B were collected from the intertidal, low marsh and two samples of *Salicornia* labeled C and D were collected from the more upland, high marsh. In the estuarine and fresh water areas of the survey, the dominant low and high marsh plants were collected as before, labels A and B designated low marsh and C and D designated high marsh. Due to the variability of the less marine habitats, plant species varied between *Typha*, *Scirpus*, and *Salicornia*, depending on the wetland area. Each sample collected consisted of the amount of plant material that could be encompassed by a 28.7-cm square made from a folding carpenter's ruler, or 823.7 cm^2. The plants were clipped 5 cm above the ground. Plant material from each sample was placed in a Ziploc bag or a trash can liner, depending on the amount of vegetation, and placed on ice for shipment to the WES.

After the plants were collected a soil sample of the surface material was collected from each of the sampling locations, A-D. Soil samples were placed in Ziploc bags and placed on ice for shipment to WES. A refractometer was used to measure the salinity of the water.

Any animals suitable as sentinel species were collected at each field collection site. Animal collections represent a composite sample rather than two discrete points within the field site. When a single species was found in sufficient numbers to provide appropriate biomass for chemical analysis, the animals were collected, placed in Ziploc bags and placed on ice for shipment to WES.

At each site the location was plotted on a map (Figures II-2, II-3, and II-4) and an aerial photograph was made of the site, looking north at 30- to 45-m altitude (Figure II-5 - II-16).

Laboratory Procedures. Plant, animal, and soil samples were shipped and stored at 4°C until processed. The plant leaf samples were rinsed three times in reverse osmosis (RO) purified water blotted with paper towels, and weighed. Animal sentinel species (mollusks) were rinsed in RO water and the soft tissues removed from the shells. Only the soft tissues were submitted for chemical analysis. Soil samples were composited to form one sample from each field site. Plant tissue, animal tissue, and soils were placed in acid-washed, hexane-rinsed glassware and shipped at 4°C to Battelle Pacific Northwest Laboratory for chemical analysis. Freeze dried and ground sediment samples were analyzed by energy dispersive X-ray fluorescence for As, Cr, Cu, Ni, Pb and Zn (Nielson and Sanders 1983). The other metals were analyzed by atomic absorption spectrometry (AA) after the sediment was totally dissolved in a mixture of nitric, perchloric and hydrofluoric acids at an elevated temperature (130 degrees C) in a sealed Teflon container. Mercury was quantified by cold vapor atomic absorption spectrometry and the other metals (Ag, Cd and Sb) were quantified by Zeeman graphite furnace AA with matrix modifiers. Sediment and tissue samples were extracted with a mixture of methylene chloride, tropolone and sodium sulfate for

the Tributyltin (TBT) analyses. The extract was derivatized and analyzed by gas chromatography with a flame photometric detector (GC-FPD) similar to the method of Ungery et al. (1986). Sediments were analyzed for base-neutral acids using US EPA Method 625, which indicates solvent extraction, column cleanup and the quantification by GC/MS. The PCBs and DDT were analyzed by US EPA Method 8080 which quantified by GC-ECD. Volatiles were analyzed by US EPA Method 624 using GC/MS. All samples for tributyltin analyses were placed in hexane rinsed and oven-dried amber glass containers and frozen prior to shipping.

Figure II-1. Sampling was Accomplished by Helicopter.

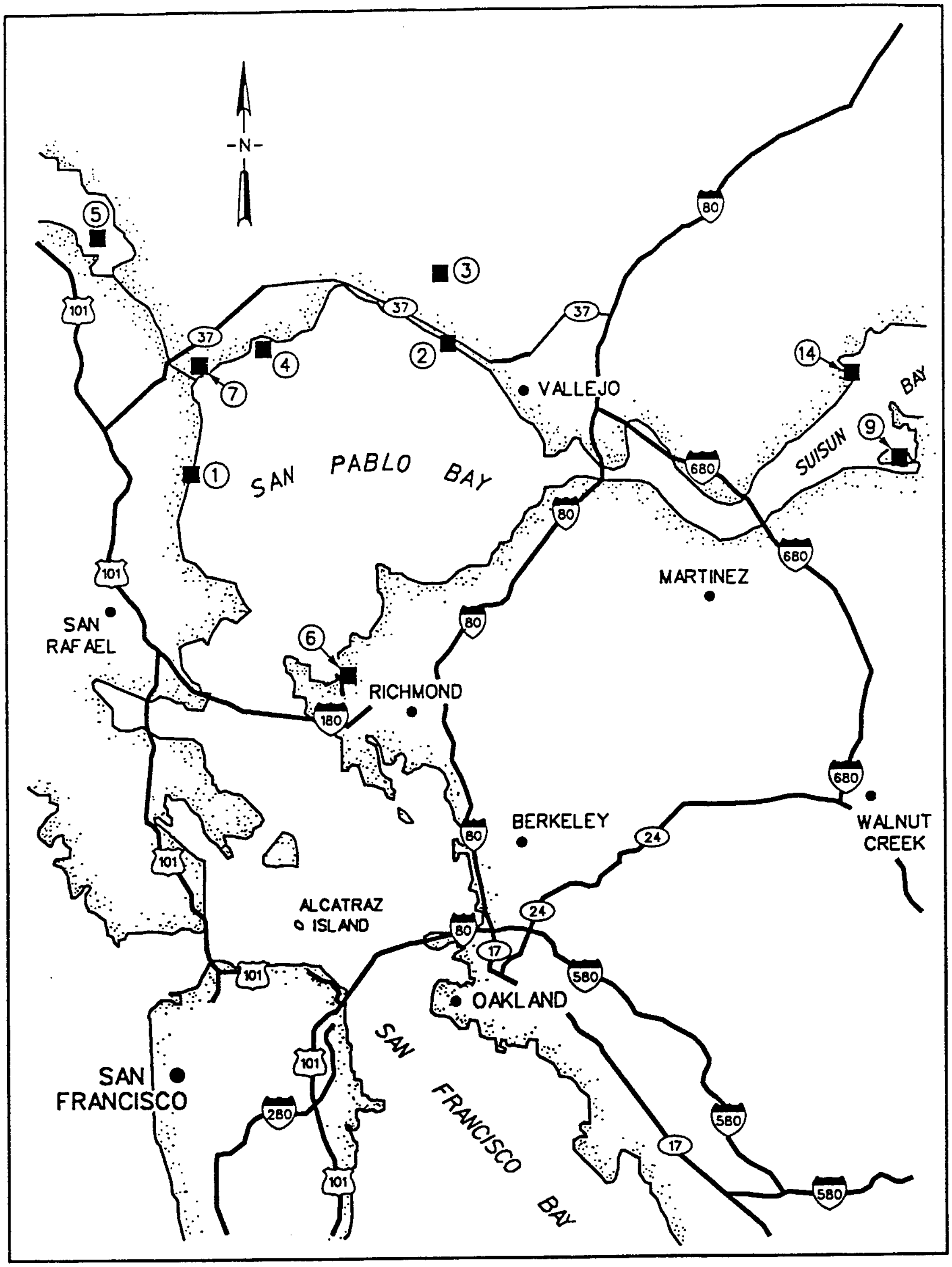

Figure II-2. Field Survey Map for Sites 1-7, 9, and 14.

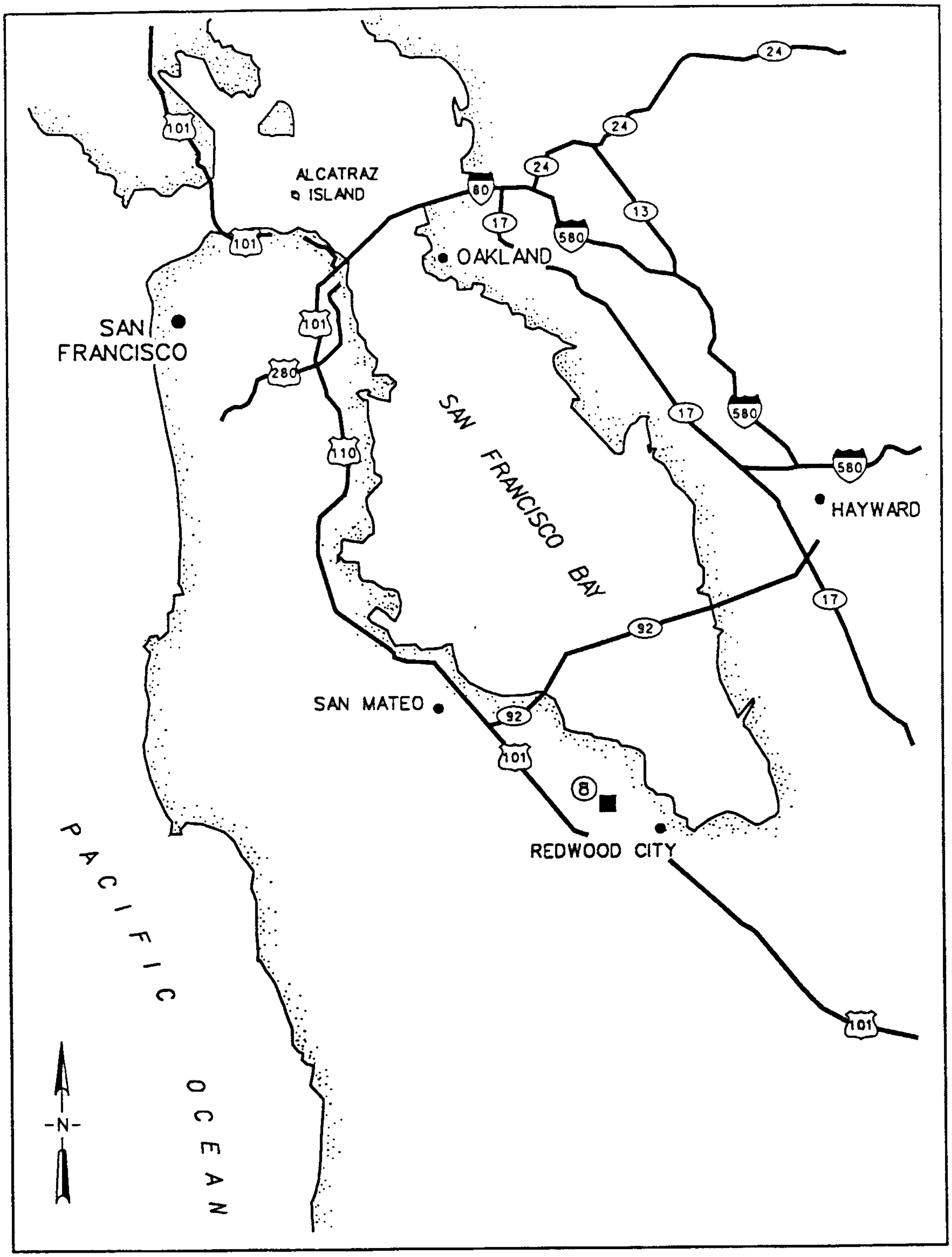

Figure II-3. Field Survey Map for Site 8.

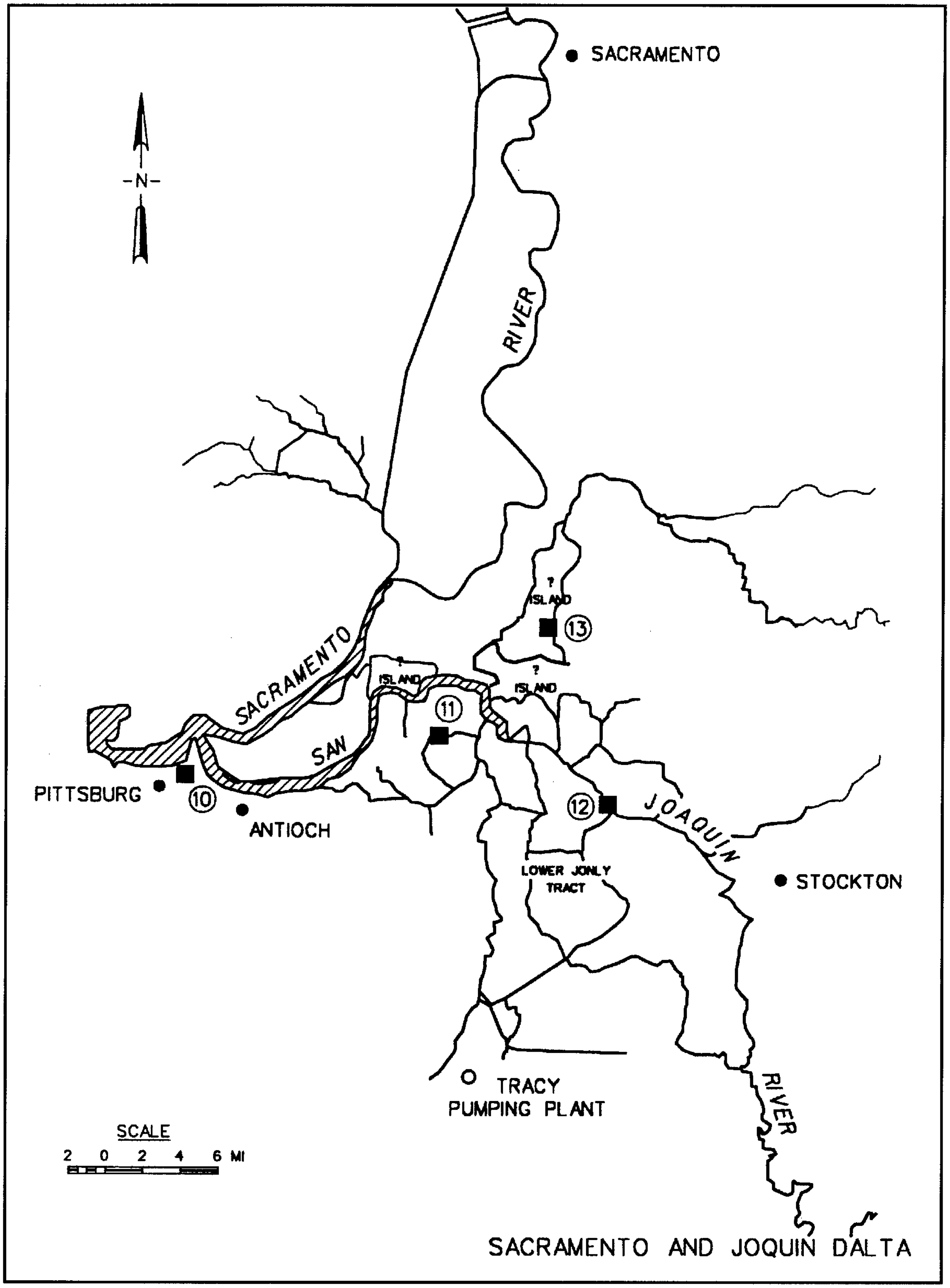

Figure II-4. Field Survey Map for Sites 10-13.

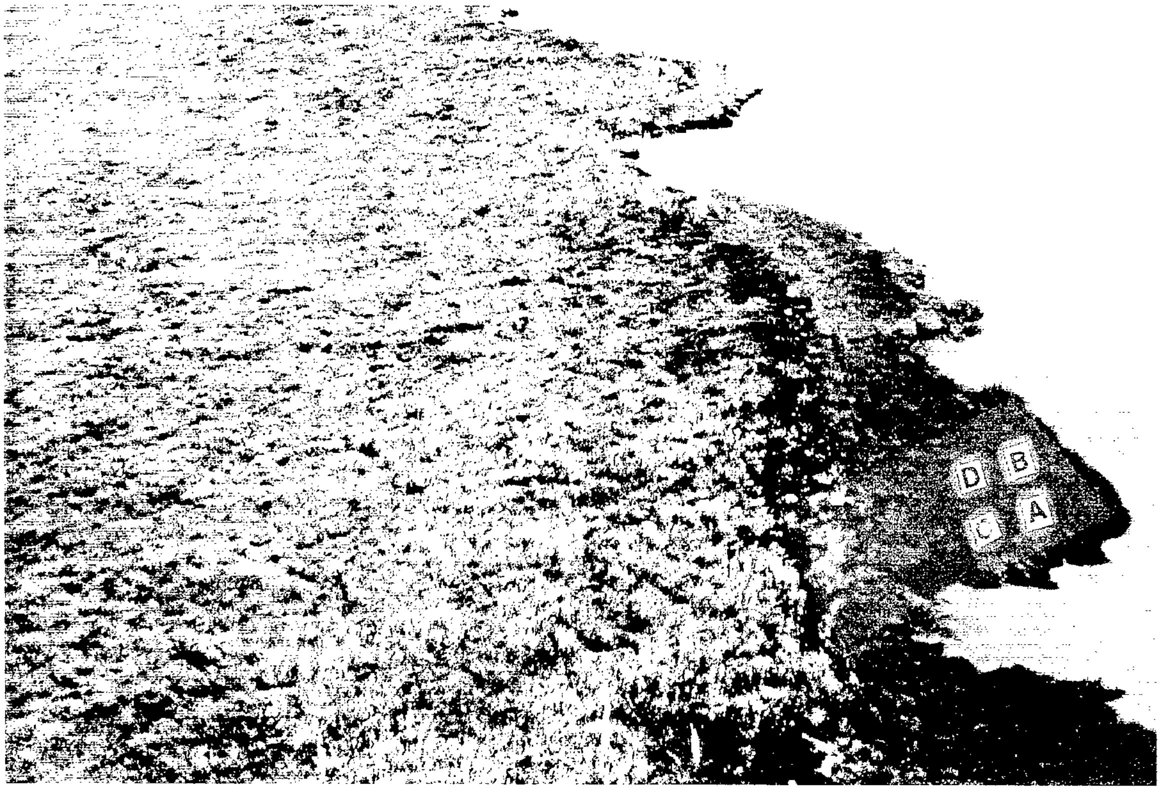

Figure II-5. Field Sampling Site 1 Hamilton Air Force Base (Reference)

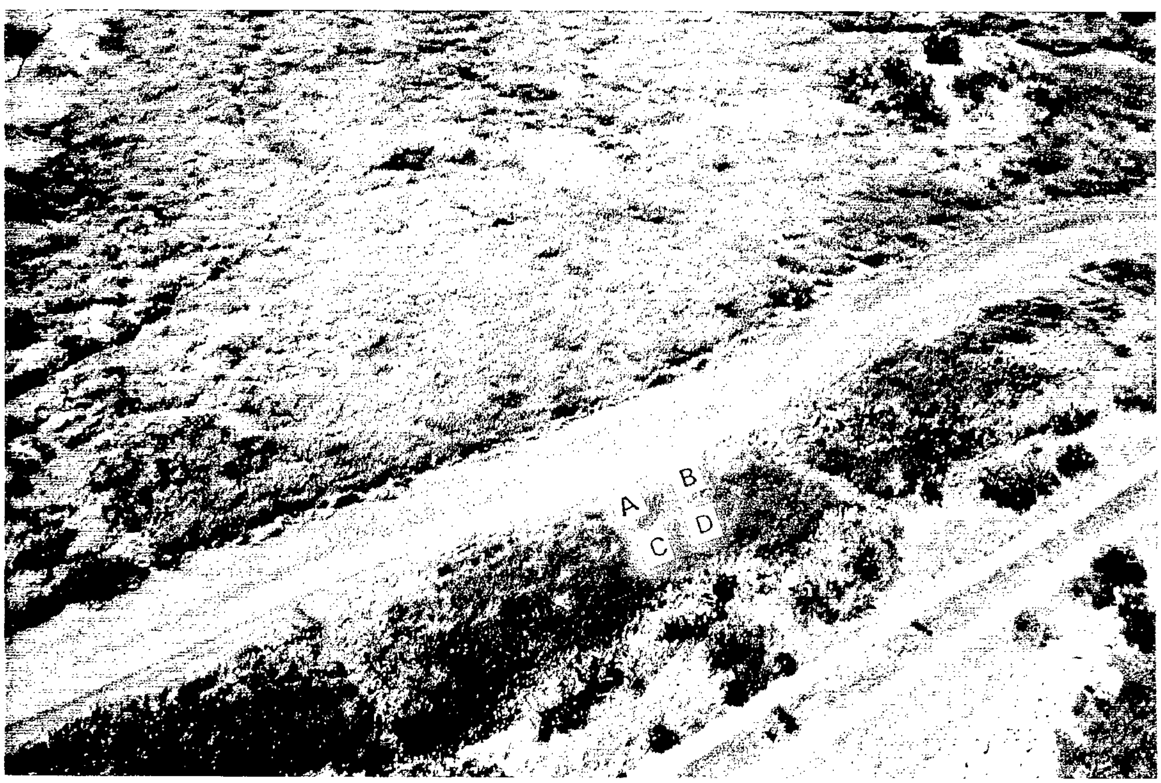

Figure II-6. Field Sampling Site 2 Sears Point Road/ Cullinan Ranch

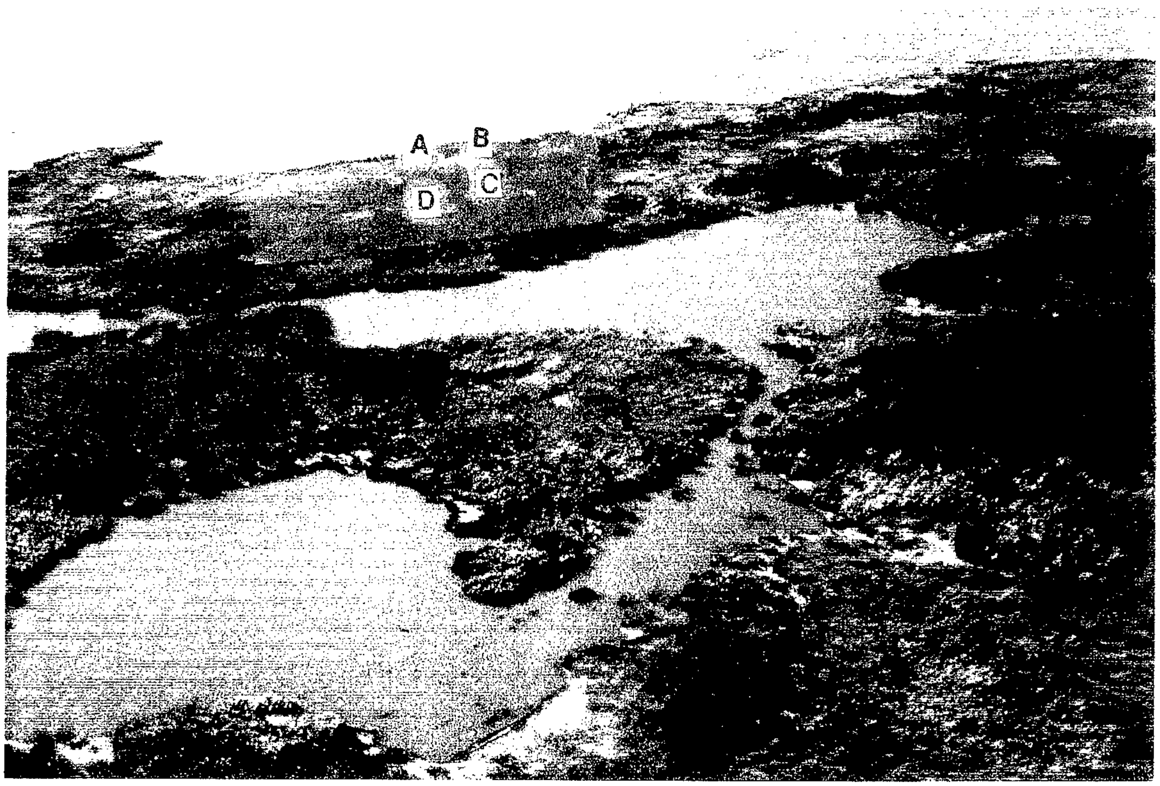

Figure II-7. Field Sampling Site 3 Dutchman Slough/ Cullinan Ranch

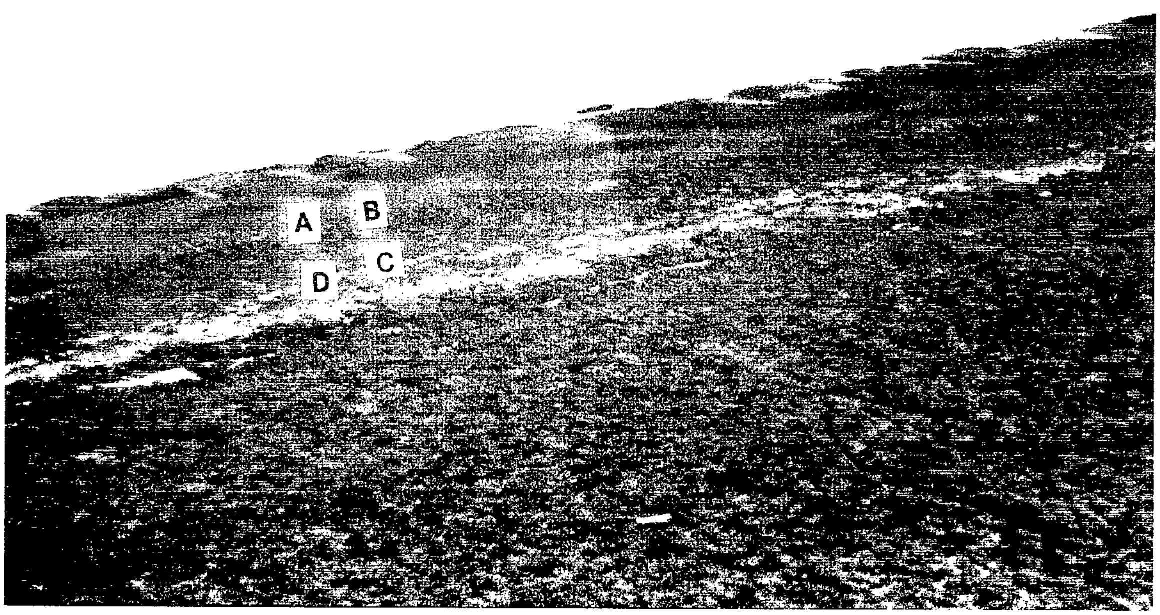

Figure II-8. Field Sampling Site 4 Lower Tubbs Island Wetland

Figure II-9. Field Sampling Site 5 Petaluma Marsh

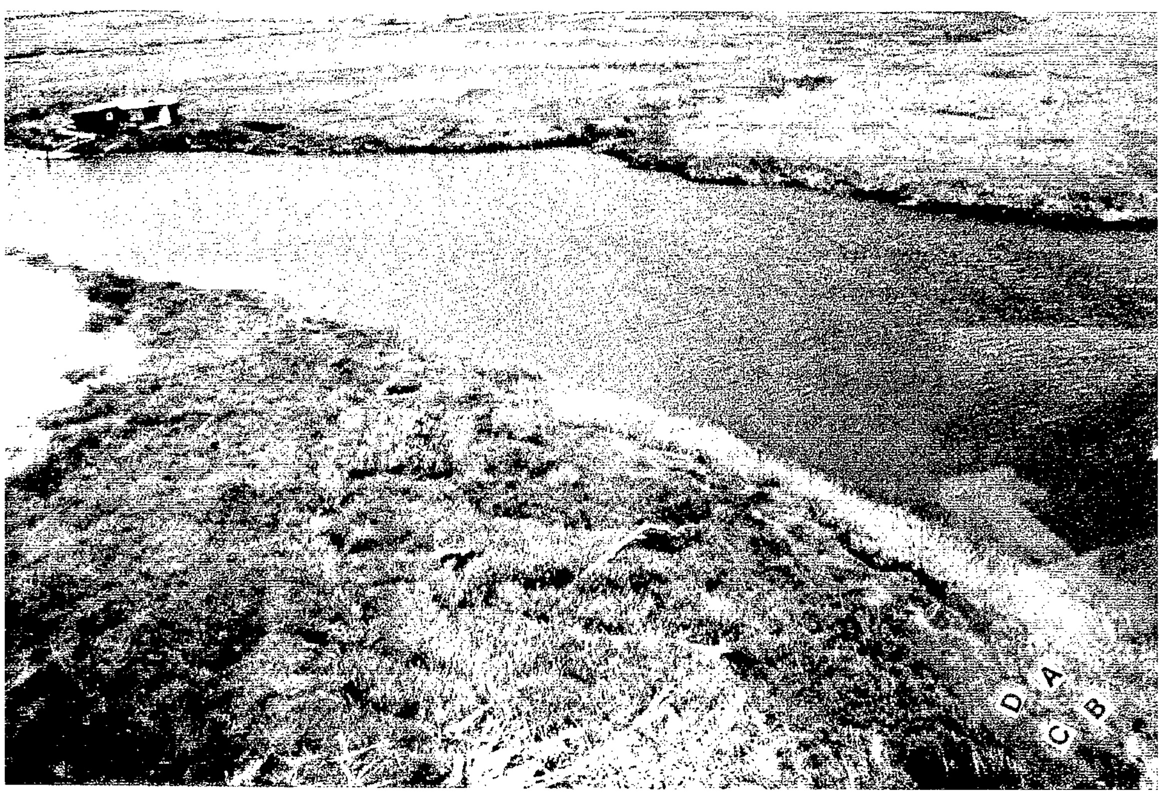

Figure II-10. Field Sampling Site 7 Sonoma Baylands

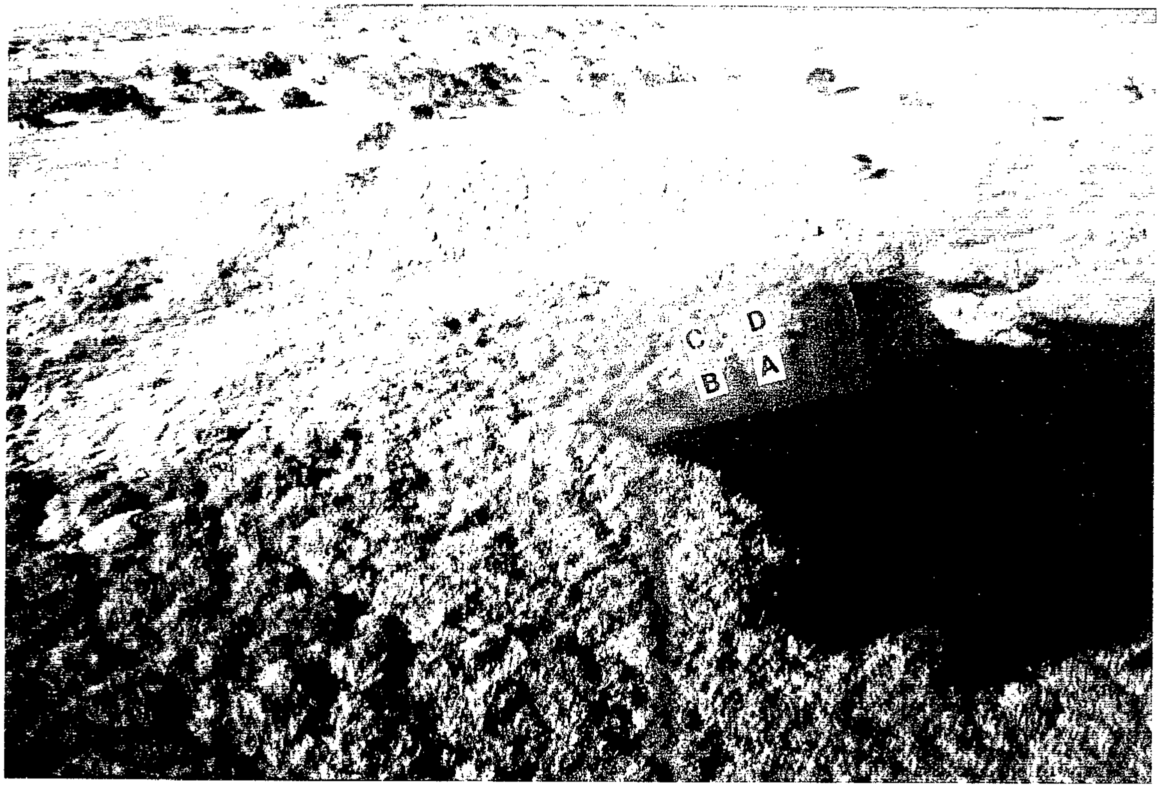

Figure II-11. Field Sampling Site 8 Deepwater Slough

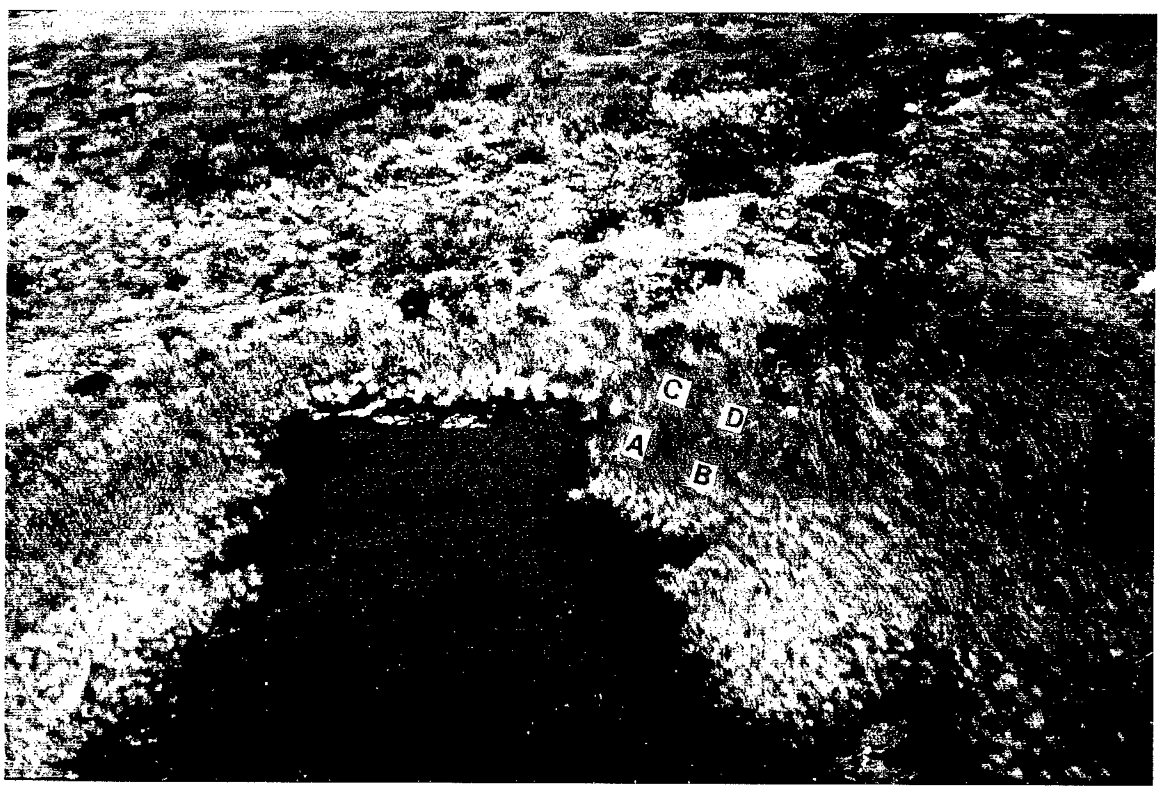

Figure II-12. Field Sampling Site 9 Roe Island, NWS Concord

Figure II-13. Field Sampling Site 10 Browns Island

Figure II-14. Field Sampling Site 11 Near Franks Tract

20

Figure II-15. Field Sampling Site 13 Staton Island, South Fork

Figure II-16. Field Sampling Site 14 Suisun Slough (Reference)

Results and Discussion

Chemical Analysis. Results of the analyses for metal, butyltin, PAH, PCB, and pesticide contaminants are shown in Tables II-2 through II-6. Metal concentrations (Table II-3) represent naturally-occurring background levels for the enormous San Francisco Bay area. These levels of metals result from the presence of heavy metals in the earth's crust, water borne metals, metals in tide water and any atmospheric fallout. These data represent areas thought to be relatively undisturbed, and uncontaminated by agricultural or industrial activities (Site 8 however, was the only disturbed site that had been created from dredged material). While the sediment arsenic concentrations are relatively low and range up to 23.7 mg/kg for site 1 and plant tissue contents are at or below detection limits, those few animals collected had tissue arsenic concentrations approaching or at a FDA-type tissue arsenic content of 10 ug/g (dry weight basis) for mollusks and crustacea used by Australia (Lee et al. 1991). While the few animals sampled in this field survey did not show elevated levels of chromium, zinc or lead, snails collected from the Tiburon area and used in wetland bioassays of dredged material from Oakland Harbor and J. F. Baldwin Ship Channel showed levels of chromium up to 74.9 ug/g, zinc up to 797 ug/g and lead up to 31.6 ug/g (Lee et al. 1994). These bioassays were conducted at the same time of the Field Survey and indicate that chromium, zinc and lead concentrations in certain native wetland animals may be elevated in the San Francisco Bay area. Of particular concern is the lead levels that appear to approach and exceed the 25 ug/g lead concentration established in Australia for human consumption of mollusc. Both Spartina and Salicornia plant species collected during the Field Survey showed tissue lead concentrations up to 4.9 and 5.4 ug/g, respectively. These values approach and exceed the 5.0 ug/g concentration established by the Dutch for mixed animal feed (van Driel et al. 1985). These data suggest that lead contents of some wetland plants and certain wetland animals in existing wetlands may be of concern to the foodwebs associated with these sites in the San Francisco Bay area. The presence of copper at what may appear to be an elevated level in the animals collected at the field sites is likely related to the copper-containing respiratory pigment

characteristic of the Mollusca as a group. The butyltin levels are generally near or below detection limits with the exception of tributyltin in bivalve mollusks (Table II-2). Butyltin values in boldface print are above detection limits. Modiolus collected at Site 1 contained 34.9-38.3 ug/kg tributyltin and Corbicula collected at Site 13 contained 40.7 ug/kg. These levels are the highest determined in any survey animals and probably reflect trace amounts accumulated from the water filtered by these mollusks. Since butyltins do not exist in nature, the levels reported are assumed to be the result of contamination from marine antifouling coatings. PCBs were not found above the detection limits with the exception of some trace amounts of Aroclor 1254 in the wetland soils collected at Sites 1-4 (Table II-4). As noted for butyltin compounds, PCBs are not found naturally in the environment and their presence above detection limits indicates some anthropomorphic contamination. The presence of some PAHs at levels greater than detection in the wetland soils at some sites may also be indicative of anthropomorphic influences (Table II-5). Those PAHs indicated in boldface print are above the detection limits but at the same time they are still relatively low and generally do not exceed 50-100 ug/kg. Pesticides were notably below detection limits with only a few exceptions (boldfaced in Table II-6).

The naturally-occurring wetlands in the San Francisco region that were selected for this survey appeared to be relatively uncontaminated by post-settlement agriculture and industrialization. Even Site 8 constructed on dredged material contained only low levels of the contaminants evaluated. Arsenic tissue contents observed in the few animals collected appeared to be close or at the action level established in Australia for mollusks and crustacea. Further study of arsenic in wetland foodwebs in the San Francisco Bay area appears to be warranted. Likewise, some wetland plants and animals were observed to contain elevated levels of chromium, zinc and/or lead. Lead particularly was observed to approach and exceed tissue lead contents established for plant feed mixes by the Dutch and lead concentrations in mollusks established by the Australian. Further evaluation of chromium, zinc and lead in existing wetlands of San Francisco Bay appears to be warranted.

Although the levels of anthropomorphic contaminants appear to be low, all the selected sites were characterized by a lack of animals, particularly those that could have been used as sentinel species. All the marine sites were characterized by the dead remains of what must have only recently been extensive beds of ribbed mussels. Although the plant communities have survived, there is a need to at least develop a plausible explanation for the lack of living mussels. The introduction and proliferation of a tiny exotic clam from Asia, Potamocorbula amurensis may be a contributing factor. This species out-competes and is a more efficient feeder than existing species. In the brackish and freshwater sites, the clam Corbicula was represented also by many shells and only a few live animals. The invasion of Potamocorbula amurensis also includes brackish waters such as in Suisun Bay. Snails were equally scarce on all sites but Site 8. This lack of animals is quite peculiar since the snails, and mussels are invasive species from the U. S. East Coast, and the clams are an equally opportunistic species from Asia. While it is likely that the introduction of the exotic species (Nassarius, Modiolus, and Corbicula) accompanied some disturbance of the California wetlands, these are very hardy species and would have been expected to survive subsequent disturbances. However, Potamocorbula amurensis could even be out-competing these species. It is realized that the entire San Francisco Bay area has suffered from an extensive drought over the past five years and could have contributed to the observation of few live animal species in the wetlands sampled. Likewise, the faunal component of San Francisco Bay wetlands is not well documented and perhaps the fauna may not be particularly diverse or abundant in the West Coast wetlands.

Table II-1. Wetland Field Survey Site List of Samples Collected.

Site	Location	Samples
1	Hamilton Air Force Base/Antenna Field Natural saltmarsh, 26 ppt. Selected as reference marsh for laboratory tests	Spartina foliosa (2)+ Salicornia sp. (2) Mussels (1) Soil (4)
2	Sears Point Road, adjacent to Cullinan Ranch, recent accreted sediment salt marsh, 30 ppt	Spartina foliosa (2) Salicornia sp. (2) Soil (4)
3	Dutchman Slough, adjacent to Cullinan Ranch, natural salt/brackish marsh, 22 ppt	Spartina foliosa (2) Salicornia sp. (2) Soil (4)
4	Lower Tubbs Island, natural salt marsh 29 ppt	Spartina foliosa (2) Salicornia sp. (2) Soil (4)
5	Petaluma Marsh, natural brackish marsh 27 ppt	Spartina foliosa (2) Salicornia sp. (2) Soil (4)
6	Castro Cove, natural salt marsh,	no permission
7	Sonoma Baylands, natural salt marsh, adjacent to potential restoration site 32 ppt	Spartina foliosa (2) Salicornia sp. (2) Soil (4)
8	Deepwater Slough, salt marsh on dredged material, some contamination, 45 ppt	Salicornia sp. (4) Snails (1) Soil (4)
9	Roe Island, NWS Concord, natural brackish marsh, 8 ppt	Scirpus sp. (4) Soil (4)
10	Browns Island, natural brackish marsh, 4 ppt	Typha sp. (4) Soil (4)
11	Near Franks Tract, natural freshwater marsh, a potential restoration site, <2 ppt	Scirpus sp. (4) Soil (4)
12	San Joaquin River, natural freshwater marsh, between Rindge & McDonald tracts	omitted
13	Staton Island, on South Fork, below Brack tract, freshwater marsh, 0 ppt	Typha sp. (4) Corbicula sp. (1) Soil (4)
14	Suisun Slough, natural brackish marsh, 10-12 ppt, selected as reference marsh for laboratory tests	Scirpus sp. (2) Salicornia sp. (2) Soil (4)

+ number of samples

Table II-2. Butyltin Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg dry-weight)

Site		Tetrabutyl Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
1	Soil	<1.3	2.3	<1.4	<1.3
	Plants				
	Spartina a	<4.7	9.2	<4.3	19.8
	Spartina b	<3.3	<3.7	<3.1	<3.1
	Salicornia c	<1.6	<1.8	<1.5	<1.5
	Salicornia d	<3.2	7.4	<2.9	21.1
	Animals				
	Modiolus R1	<3.9	34.9	9.3	7.8
	Modiolus R2	<5.0	38.3	<5.0	<4.6
2	Soil	0.5	2.6	3.6	17.0
	Plants				
	Spartina a	<2.3	<2.5	<2.2	<2.2
	Spartina b	<3.1	<3.4	<2.9	<2.9
	Salicornia c	9.7	6.5	<3.5	7.1
	Salicornia d	<3.2	7.4*	<2.9	12.5*
3	Soil	3.0	2.6	<1.4	2.9
	Plants				
	Spartina a	<2.1	2.9	<2.1	<1.9
	Spartina b	<3.6	8.3	3.7	5.1
	Salicornia c	2.2	3.1	6.6	15.6
	Salicornia d	3.3	4.8	4.4	7.1
4	Soil	<1.4	3.1	2.0	2.3
	Plants				
	Spartina a	2.7	5.2	2.5	NA
	Spartina b	<4.2	<4.6	<3.9	<3.9
	Salicornia c	3.2	6.0	19.0	64.3
	Salicornia d	<3.2	7.0*	<2.9	17.6
5	Soil	<1.2	3.1	1.7	<1.2
	Plants				
	Spartina a	<2.2	5.2	<2.2	<2.0
	Salicornia c	<2.9	6.0*	<2.7	18.1
	Salicornia d	54.7	35.8	2.3	5.3
7	Soil	2.9	2.0	9.6	2.1
	Plants				
	Spartina a	<4.1	<4.4	<3.8	<3.8
	Spartina b	<3.3	<3.6	<3.1	<3.1
	Salicornia c	8.2	9.6*	5.6	6.1
	Salicornia d	<5.8	12.6*	13.2	<5.3
8	Soil	2.0	2.3	<1.4	<1.3
	Salicornia a	2.4	4.5	2.2	53.5
	Salicornia b	<3.1	5.3	<3.1	<2.9
	Salicornia c	2.0	3.5	11.1	24.6
	Salicornia d	<2.3	4.0	2.8	2.1
	Animals				
	Cerithidea?	<1.4	3.5	4.2	1.7
	Cerithidea?	<0.6	1.4	0.9	1.6

Table II-2 Concluded. Butyltin Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg dry-weight)

Site		Tetrabutyl Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
9	Soil	<1.9	3.2	9.6	2.1
	Plants				
	Scirpus a	6.1	8.3*	4.6	4.3
	Scirpus b	<3.2	6.5*	<2.9	<2.9
	Scirpus c	<3.8	8.4*	3.6	5.0
	Scirpus d	<5.1	14.7*	6.7	<4.6
10	Soil	<1.5	3.6	<1.6	4.7
	Plants				
	Typha a	11.4*	4.7*	2.5*	9.5*
	Typha b	6.1*	5.7*	3.0*	4.1*
	Typha c	11.0*	3.9*	2.8*	<2.2
	Typha d	6.3*	2.2*	3.7*	14.0*
11	Soil	<0.9	33.4	<0.9	<0.9
	Plants				
	Scirpus a	<4.1	5.6	5.6	<3.7
	Scirpus b	5.5	5.2	2.6	9.5
	Scirpus c	<2.2	4.1	<2.1	4.4
13	Soil	<0.9	1.8	<0.9	<0.9
	Plants				
	Typha a	13.1*	8.4*	4.4*	7.0*
	Typha b	14.7*	6.8*	4.1*	5.5*
	Typha c	<3.2	<3.6	<3.0	<3.0
	Typha d	18.3*	4.3*	2.3*	3.3*
	Animals				
	Corbicula	14.6	40.7	30.1	11.8
14	Soil	<1.3	3.5	1.8	2.4
	Plants				
	Scirpus a	1.2	2.2	1.1	NA
	Salicornia c	2.4	4.8	2.2	35.1
	Salicornia d	<3.1	4.4	<3.0	5.6

* indicates analyte detected in the blank

Table II-3. Heavy Metal Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in mg/kg dry-weight)

Site		As	Cr	Cu	Ni	Pb	Se	Zn	Cd	Hg
1	Soil	23.7	174.0	71.6	102.0	36.3	0.33	137.2	0.33	0.515
	Plants									
	Spartina a	<0.96	<4.7	4.63	1.96	4.1	<0.74	27.6	0.055	0.006
	Spartina b	<0.86	7.1	4.35	4.34	2.2	<0.64	21.2	0.032	0.015
	Salicornia c	<1.0	4.2	7.92	3.07	4.1	<0.77	18.0	0.051	0.01
	Salicornia d	0.94	<3.7	10.45	2.71	<2.4	<0.70	16.6	0.069	0.012
	Animals									
	Modiolus R1	8.76	4.0	23.1	7.74	1.71	4.19	71.7	3.53	0.398
	Modiolus R2	8.93	3.3	20.5	5.33	1.39	3.52	71.1	3.45	0.304
2	Soil	18.5	219.0	90.6	125.4	36.8	0.33	158.9	0.32	0.469
	Plants									
	Spartina a	<1.2	8.9	6.44	4.61	3.0	0.85	30.5	0.063	0.02
	Spartina b	<1.1	<6.3	7.2	4.11	4.7	<0.76	34.8	0.066	0.02
	Salicornia c	<0.91	1.8	10.8	2.47	0.61	<2.20	40.0	0.16	0.019
	Salicornia d	<1.1	10.6	13.9	6.07	3.9	<0.78	31.5	0.089	0.022
3	Soil	18.2	179.0	70.1	145.2	33.0	0.42	166.1	0.41	0.166
	Plants									
	Spartina a	1.27	7.2	13.7	8.76	1.39	<0.63	98.0	0.06	0.022
	Spartina b	1.04	7.7	13.9	9.29	1.84	<0.64	84.9	0.12	0.025
	Salicornia c	1.0	1.8	8.0	3.31	0.66	<0.65	26.6	0.05	0.016
	Salicornia d	<0.86	2.6	12.0	5.27	0.93	<0.64	25.8	0.08	0.021
4	Soil	13.4	214.0	72.6	135.5	35.7	0.17	160.1	0.31	0.439
	Plants									
	Spartina a	1.82	2.5	8.9	2.05	0.60	<0.68	60.9	0.07	0.014
	Spartina b	<1.2	<6.9	6.43	3.24	4.9	<0.85	25.9	0.043	0.012
	Salicornia c	<1.0	5.9	19.1	6.29	1.42	<0.79	45.7	0.29	0.038
	Salicornia d	<0.76	4.6	6.52	1.66	<2.10	<0.63	12.04	0.094	0.014
5	Soil	14.4	179.0	67.6	125.9	34.1	0.25	158.4	0.26	0.419
	Plants									
	Spartina a	0.99	8.5	11.4	9.1	2.04	<0.65	65.5	0.08	0.027
	Spartina b	<1.1	<5.1	8.86	3.29	<2.7	<0.81	44.9	0.22	0.008
	Salicornia c	<0.62	6.8	8.68	5.66	2.80	<0.65	15.7	0.039	0.012
	Salicornia d	<0.88	4.1	11.5	4.49	4.49	<0.66	44.3	0.06	0.018

Table II-3. Continued. Heavy Metal Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in mg/kg dry-weight)

Site		As	Cr	Cu	Ni	Pb	Se	Zn	Cd	Hg
7	Soil	10.6	195.0	67.5	119.8	33.8	0.33	157.5	0.33	0.469
	Plants									
	Spartina a	<1.1	<6.0	4.64	4.29	3.6	<0.79	28.5	0.043	0.009
	Spartina b	<0.99	8.9	6.1	7.40	2.7	<0.72	25.5	0.064	0.017
	Salicornia c	1.14	6.6	8.79	5.37	<2.30	<0.69	19.5	0.067	0.011
	Salicornia d	2.20	25.4	17.7	19.20	5.40	<0.73	37.5	0.10	0.059
8	Soil	5.29	224.0	35.9	72.2	20.9	<0.14	88.5	0.14	0.074
	Plants									
	Salicornia a	<0.003	0.4	9.7	<1.7	0.23	<1.10	27.3	0.13	0.024
	Salicornia b	<0.99	0.5	8.8	1.47	0.49	<0.77	57.4	0.10	0.018
	Salicornia c	<0.85	0.4	8.7	1.48	0.92	<0.66	36.0	0.21	0.030
	Salicornia d	<0.83	0.4	8.9	<0.93	0.38	<0.65	36.3	0.15	0.025
	Animals									
	Cerithidea? 1	*11.62*	*2.2*	*93.6*	*10.2*	*1.15*	*1.33*	*401.0*	*1.03*	*0.180*
	Cerithidea? 1	9.22	2.1	74.3	8.5	1.43	1.04	309.0	1.03	0.172
	Cerithidea? 2	2.5	1.2	23.5	4.5	0.82	1.47	131.4	0.34	0.055
9	Soil	19.3	183.0	68.5	107.7	85.6	0.41	142.2	0.28	0.383
	Soil (dup)	20.7	168.0	72.4	106.6	84.6	0.39	145.5	0.28	0.394
	Plants									
	Scirpus a	<0.71	6.4	6.83	4.26	<2.0	<0.60	41.7	0.20	0.020
	Scirpus b	<0.82	3.9	6.64	7.92	2.50	<0.62	43.5	0.37	0.026
	Scirpus c	<4.2	<4.2	10.13	2.03	2.50	<0.65	39.7	0.35	0.012
	Scirpus d	<0.79	3.9	5.52	1.97	<2.00	<0.58	27.2	0.19	0.024
10	Soil	17.2	126.0	67.9	93.3	47.8	0.91	135.0	0.56	0.321
	Plants									
	Typha a	<0.79	<3.4	4.06	2.28	<2.0	<0.63	19.0	0.035	0.016
	Typha b	<0.77	<3.6	4.95	2.16	<1.9	<0.63	17.8	0.067	0.026
	Typha c	<0.79	<3.5	5.36	2.64	2.19	<0.63	18.6	0.055	0.022
	Typha d	<0.87	<4.1	10.18	2.54	<2.1	<0.69	21.3	0.100	0.012

Table II-3. Concluded. Heavy Metal Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in mg/kg dry-weight)

Site		As	Cr	Cu	Ni	Pb	Se	Zn	Cd	Hg
11	Soil	15.3	181.0	50.3	83.3	13.7	0.16	89.8	0.22	0.283
	Plants									
	Scirpus a	0.87	2.7	31.1	6.70	0.87	<0.62	89.9	0.17	0.050
	Scirpus b	<0.89	4.0	17.4	9.39	1.03	<0.65	133.0	0.24	0.044
	Scirpus c	<0.79	0.7	15.3	4.47	0.49	<0.56	88.7	0.16	0.018
	Scirpus d	<0.84	1.9	13.6	5.81	0.76	<0.61	59.3	0.13	0.028
13	Soil	5.36	110.0	24.2	32.2	14.0	<0.14	161.7	0.55	0.059
	Plants									
	Typha a	<0.91	<7.1	9.41	7.40	4.0	<0.66	61.0	0.13	0.014
	Typha b	*<0.9*	*8.0*	*7.59*	*9.40*	*2.3*	*<0.63*	93.6	0.14	0.015
	Typha c	<0.87	<4.2	5.12	4.27	2.8	<0.62	34.3	0.07	0.016
	Typha d	<0.83	<4.0	4.0	8.31	<2.1	<0.62	98.8	0.09	0.010
	Animals									
	Corbicula	10.79	4.3	164.1	5.78	1.89	3.98	273.0	3.34	0.469
14	Soil	16.9	193.0	77.3	122.1	32.5	0.25	164.7	0.36	0.362
	Plants									
	Scirpus a	<0.79	3.3	7.7	3.47	1.18	<0.58	48.4	0.08	0.038
	Salicornia c	<0.92	3.6	10.1	3.78	0.99	<0.70	30.8	0.17	0.034
	Salicornia d	<0.95	1.7	11.4	1.85	0.71	<0.71	29.8	0.07	0.019

Table II-4. PCB Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
1	Soil	<30	<30	<30	<30	<30	150	<30
	Plants							
	Spartina a	<100	<100	<100	<100	<100	<100	<100
	Spartina b	<100	<100	<100	<100	<100	<100	<100
	Salicornia c	<100	<100	<100	<100	<100	<100	<100
	Salicornia d	<100	<100	<100	<100	<100	<100	<100
	Animals							
	Modiolus R1	<100	<100	<100	<100	<100	<100	<100
	Modiolus R2	<100	<100	<100	<100	<100	<100	<100
2	Soil	<30	<30	<30	<30	<30	83	<30
	Plants							
	Spartina a	<100	<100	<100	<100	<100	<100	<100
	Spartina b	<100	<100	<100	<100	<100	<100	<100
	Salicornia c	<20	<20	<20	<20	<20	<20	<20
	Salicornia d	<100	<100	<100	<100	<100	<100	<100
3	Soil	<30	<30	<30	<30	<30	210	<30
	Plants							
	Spartina a	<20	<20	<20	<20	<20	<20	<20
	Spartina b	<20	<20	<20	<20	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<20	<20
4	Soil	<30	<30	<30	<30	<30	120	<30
	Plants							
	Spartina a	<20	<20	<20	<20	<20	<20	<20
	Spartina b	<100	<100	<100	<100	<100	<100	<100
	Salicornia c	<20	<20	<20	<20	<20	<20	<20
	Salicornia d	<100	<100	<100	<100	<100	<100	<100
5	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Spartina a	<20	<20	<20	<20	<20	<20	<20
	Spartina b	<100	<100	<100	<100	<100	<100	<100
	Salicornia c	<100	<100	<100	<100	<100	<100	<100
	Salicornia d	<20	<20	<20	<20	<00	<100	<100

Table II-4 Continued. PCB Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
7	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Spartina a	<100	<100	<100	<100	<100	<100	<100
	Spartina b	<100	<100	<100	<100	<100	<100	<100
	Salicornia c	<100	<100	<100	<100	<100	<100	<100
	Salicornia d	<100	<100	<100	<100	<100	<100	<100
8	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Salicornia a	<20	<20	<20	<20	<20	<20	<20
	Salicornia b	<20	<20	<20	<20	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<20	<20
	Animals							
	Cerithidea? 1	<100	<100	<100	<100	<100	<100	<100
	Cerithidea? 2	<100	<100	<100	<100	<100	<100	<100
9	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Scirpus a	<100	<100	<100	<100	<100	<100	<100
	Scirpus b	<100	<100	<100	<100	<100	<100	<100
	Scirpus c	<100	<100	<100	<100	<100	<100	<100
	Scirpus d	<100	<100	<100	<100	<100	<100	<100
10	Soil	<50	<50	<50	<50	<50	<50	<50
	Plants							
	Typha a	<100	<100	<100	<100	<100	<100	<100
	Typha b	<100	<100	<100	<100	<100	<100	<100
	Typha c	<100	<100	<100	<100	<100	<100	<100
	Typha d	<100	<100	<100	<100	<100	<100	<100
11	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Scirpus a	<20	<20	<20	<20	<20	<20	<20
	Scirpus b	<20	<20	<20	<20	<20	<20	<20
	Scirpus c	<20	<20	<20	<20	<20	<20	<20
	Scirpus d	<20	<20	<20	<20	<20	<20	<20

Table II-4 Concluded. PCB Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
13	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Typha a	<100	<100	<100	<100	<100	<100	<100
	Typha b	<100	<100	<100	<100	<100	<100	<100
	Typha c	<100	<100	<100	<100	<100	<100	<100
	Typha d	<100	<100	<100	<100	<100	<100	<100
	Animals							
	Corbicula	<100	<100	<100	<100	<100	<100	<100
14	Soil	<30	<30	<30	<30	<30	<30	<30
	Plants							
	Scirpus a	<20	<20	<20	<20	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<20	<20

Table II-5. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Acenaph-thene	Acenaph-thylene	Anthr-acene	Benzo[a] Anthracene	Benzo[b] Fluoranthene	Benzo[k] Fluoranthene	Benzo[a] Pyrene
1	Soil	12	15	38	100	96	82	130
	Plants							
	Spartina a	<10	<10	<10	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
	Animals							
	Modiolus R1	<10	<10	<10	<10	<10	<10	<10
	Modiolus R2	<10	<10	<10	<10	<10	<10	<10
2	Soil	<10	<10	15	41	58	44	63
	Plants							
	Spartina a	<10	<10	26	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
3	Soil	<10	<10	<10	22	40	26	39
	Plants							
	Spartina a	<10	<10	<10	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
4	Soil	<10	<10	15	47	67	50	80
	Plants							
	Spartina a	<10	<10	<10	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Acenaph-thene	Acenaph-thylene	Anthr-acene	Benzo[a] Anthracene	Benzo[b] Fluoranthene	Benzo[k] Fluoranthene	Benzo[a] Pyrene
5	Soil	<10	<10	<10	<10	<10	<10	<10
	Plants							
	Spartina a	<10	<10	<10	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
7	Soil	<10	<10	16	67	82	72	86
	Plants							
	Spartina a	<10	<10	<10	<10	<10	<10	<10
	Spartina b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
8	Soil	<10	<10	<10	<10	15	11	11
	Plants							
	Salicornia a	<10	<10	<10	<10	<10	<10	<10
	Salicornia b	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10
	Animals							
	Cerithidea? 1	<10	<10	<10	<10	<10	<10	<10
	Cerithidea? 2	<10	<10	<10	<10	<10	<10	<10
9	Soil	<10	<10	17	56	83	67	62
	Plants							
	Scirpus a	<10	<10	<10	<10	<10	<10	<10
	Scirpus b	<10	<10	<10	<10	<10	<10	<10
	Scirpus c	<10	<10	<10	<10	<10	<10	<10
	Scirpus d	<10	<10	<10	<10	<10	<10	<10
10	Soil	19	120	97	150	211	150	130
	Plants							
	Typha a	<10	<10	<10	<10	<10	<10	<10
	Typha b	<10	<10	<10	<10	<10	<10	<10
	Typha c	<10	<10	<10	<10	<10	<10	<10
	Typha d	<10	<10	<10	<10	<10	<10	<10

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Acenaph-thene	Acenaph-thylene	Anthr-acene	Benzo[a] Anthracene	Benzo[b] Fluoranthene	Benzo[k] Fluoranthene	Benzo[a] Pyrene
11	Soil	<10	<10	<10	<10	<10	<10	<10
	Plants							
	Scirpus a	<10	<10	<10	<10	<10	<10	<10
	Scirpus b	<10	<10	<10	<10	<10	<10	<10
	Scirpus c	<10	<10	<10	<10	<10	<10	<10
	Scirpus d	<10	<10	<10	<10	<10	<10	<10
13	Soil	<10	<10	<10	29	18	20	22
	Plants							
	Typha a	<10	<10	<10	<10	<10	<10	<10
	Typha b	<10	<10	<10	<10	<10	<10	<10
	Typha c	<10	<10	<10	<10	<10	<10	<10
	Typha d	<10	<10	<10	<10	<10	<10	<10
	Animals							
	Corbicula	<10	<10	<10	<10	<10	<10	<10
14	Soil	<10	<10	<10	11	18	13	16
	Plants							
	Scirpus a	<10	<10	<10	<10	<10	<10	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	<10

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Benzo [g,h,i] perylene	Chrysene	Dibenzo [a,h] anthracene	Fluor-anthene	Fluorene	Ideno-1,2,3-pyrene	2-Methyl-Naph-thalene	Naph-thalene
1	Soil	110	100	19	190	<10	99	30	61
	Plants								
	Spartina a	<10	<10	<10	<10	15	<10	29	63
	Spartina b	<10	<10	<10	<10	<10	<10	<20	42
	Salicornia c	<10	<10	<10	<10	<10	<10	20	50
	Salicornia d	<10	<10	<10	<10	<10	<10	<20	<50
	Animals								
	Modiolus R1	<10	<10	<10	<10	<10	<10	45	120
	Modiolus R2	<10	<10	<10	<10	<10	<10	<30	61
2	Soil	68	51	10	94	<10	59	27	53
	Plants								
	Spartina a	<10	<10	<10	<10	<10	<10	21	<50
	Spartina b	<10	<10	<10	<10	<10	<10	32	<50
	Salicornia c	<10	<10	<10	<10	<10	<10	24	61
	Salicornia d	<10	<10	<10	<10	<10	<10	37	98
3	Soil	53	27	<10	54	<10	43	35	64
	Plants								
	Spartina a	<10	<10	<10	<10	<10	<10	24	68
	Spartina b	<10	<10	<10	<10	<10	<10	29	88
	Salicornia c	<10	<10	<10	<10	<10	<10	<20	<50
	Salicornia d	<10	<10	<10	<10	<10	<10	28	83
4	Soil	88	53	11	110	<10	77	25	50
	Plants								
	Spartina a	<10	<10	<10	<10	<10	<10	<20	<50
	Spartina b	<10	<10	<10	<10	<10	<10	30	63
	Salicornia c	<10	<10	<10	<10	<10	<10	25	73
	Salicornia d	<10	<10	<10	<10	<10	<10	<20	41
5	Soil	<10	<10	<10	<10	<10	<10	15	34
	Plants								
	Spartina a	<10	<10	<10	<10	<10	<10	25	68
	Spartina b	<10	<10	<10	<10	<10	<10	<20	<50
	Salicornia c	<10	<10	<10	<10	<10	<10	<20	30
	Salicornia d	<10	<10	<10	<10	<10	<10	24	59

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Benzo [g,h,i] perylene	Chrysene	Dibenzo [a,h] anthracene	Fluor- anthene	Fluorene	Ideno-1,2,3-pyrene	2-Methyl-Naph-thalene	Naph-thalene
7	Soil	100	71	15	120	<10	87	12	26
	Plants								
	Spartina a	<10	<10	<10	<10	<10	<10	28	54
	Spartina b	<10	<10	<10	<10	<10	<10	<20	28
	Salicornia c	<10	<10	<10	<10	<10	<10	<20	30
	Salicornia d	<10	<10	<10	11	<10	<10	<20	30
8	Soil	15	15	<10	18	<10	11	<10	56
	Plants								
	Salicornia a	<10	<10	<10	<10	<10	<10	30	16
	Salicornia b	<10	<10	<10	<10	<10	<10	28	89
	Salicornia c	<10	<10	<10	<10	<10	<10	25	68
	Salicornia d	<10	<10	<10	<10	<10	<10	28	89
	Animals								
	Cerithidea? 1	<10	<10	<10	<10	<10	<10	<30	<60
	Cerithidea? 2	<10	11	<10	<10	<10	<10	<30	<60
9	Soil	<10	<10	17	56	83	67	NA	62
	Plants								
	Scirpus a	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus b	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus c	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus d	<10	<10	<10	<10	<10	<10	NA	<10
10	Soil	19	120	97	150	211	150	NA	130
	Plants								
	Typha a	<10	<10	<10	<10	<10	<10	NA	<10
	Typha b	<10	<10	<10	<10	<10	<10	NA	<10
	Typha c	<10	<10	<10	<10	<10	<10	NA	<10
	Typha d	<10	<10	<10	<10	<10	<10	NA	<10
11	Soil	<10	<10	<10	<10	<10	<10	NA	<10
	Plants								
	Scirpus a	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus b	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus c	<10	<10	<10	<10	<10	<10	NA	<10
	Scirpus d	<10	<10	<10	<10	<10	<10	NA	<10

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Benzo [g,h,i] Perylene	Chrysene	Dibenzo [a,h] anthracene	Fluor-anthene	Fluorene	Ideno-1,2,3-Pyrene	2-Methyl-Naph-thalene	Naph-thalene
13	Soil	<10	<10	<10	29	18	20	NA	22
	Plants								
	Typha a	<10	<10	<10	<10	<10	<10	NA	<10
	Typha b	<10	<10	<10	<10	<10	<10	NA	<10
	Typha c	<10	<10	<10	<10	<10	<10	NA	<10
	Typha d	<10	<10	<10	<10	<10	<10	NA	<10
	Animals								
	Corbicula	<10	<10	<10	<10	<10	<10	NA	<10
14	Soil	<10	<10	<10	11	18	13	NA	16
	Plants								
	Scirpus a	<10	<10	<10	<10	<10	<10	NA	<10
	Salicornia c	<10	<10	<10	<10	<10	<10	NA	<10
	Salicornia d	<10	<10	<10	<10	<10	<10	NA	<10

NA - not available

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils
(Concentration in ug/kg wet-weight)

Site		Phenanthrene	Pyrene
1	Soil	94	240
	Plants		
	Spartina a	31	<10
	Spartina b	13	<10
	Salicornia c	10	<10
	Salicornia d	28	<10
	Animals		
	Modiolus R1	37	26
	Modiolus R2	14	<10
2	Soil	36	120
	Plants		
	Spartina a	30	<10
	Spartina b	20	<10
	Salicornia c	22	<10
	Salicornia d	<10	<10
3	Soil	25	72
	Plants		
	Spartina a	14	<10
	Spartina b	14	<10
	Salicornia c	<10	<10
	Salicornia d	13	<10
4	Soil	42	140
	Plants		
	Spartina a	<10	<10
	Spartina b	38	<10
	Salicornia c	13	<10
	Salicornia d	<10	<10
5	Soil	<10	<10
	Plants		
	Spartina a	17	<10
	Spartina b	<10	<10
	Salicornia c	<10	<10
	Salicornia d	<10	<10

Table II-5 Continued. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Phenanthrene	Pyrene
7	Soil	45	160
	Plants		
	Spartina a	37	<10
	Spartina b	12	12
	Salicornia c	<10	<10
	Salicornia d	<10	12
8	Soil	<10	20
	Plants		
	Salicornia a	16	<10
	Salicornia b	12	<10
	Salicornia c	20	<10
	Salicornia d	15	<10
	Animals		
	Cerithidea? 1	<10	<10
	Cerithidea? 2	<10	10
9	Soil	20	89
	Plants		
	Scirpus a	17	19
	Scirpus b	18	11
	Scirpus c	18	19
	Scirpus d	11	<10
10	Soil	76	240
	Plants		
	Typha a	<10	<10
	Typha b	<10	<10
	Typha c	11	<10
	Typha d	20	<10
11	Soil	<10	<10
	Plants		
	Scirpus a	18	<10
	Scirpus b	18	<10
	Scirpus c	10	<10
	Scirpus d	14	<10

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Table II-5 Concluded. PAH Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Phenanthrene	Pyrene
13	Soil	20	46
	Plants		
	Typha a	12	10
	Typha b	<10	<10
	Typha c	18	<10
	Typha d	<10	<10
	Animals		
	Corbicula	<10	<10
14	Soil	13	33
	Plants		
	Scirpus a	<10	<10
	Salicornia c	<10	<10
	Salicornia d	<10	<10

Table II-6 Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aldrin	a-BHC	b-BHC	d-BHC	g-BHC	Chlor-dane	4,4-DDD	4,4-DDE	4,4-DDT
1	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Animals									
	Modiolus R1	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Modiolus R2	<10	<10	<10	<10	<10	<10	<10	<10	<10
2	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20
3	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Spartina b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<2.0	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
4	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20
5	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Table II-6 Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aldrin	a-BHC	b-BHC	d-BHC	g-BHC	Chlor-dane	4,4-DDD	4,4-DDE	4,4-DDT
7	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.6	<3.0
	Plants									
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20
8	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Salicornia a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Animals									
	Cerithidea? 1	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Cerithidea? 2	<10	<10	<10	<10	<10	<10	<10	<10	<10
9	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Scirpus a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Scirpus b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Scirpus c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Scirpus d	<20	<20	<20	<20	<20	<30	<20	<20	<20
10	Soil	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Plants									
	Typha a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha d	<20	<20	<20	<20	<20	<30	<20	<20	<20
11	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Scirpus a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Table II-6 Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Aldrin	a-BHC	b-BHC	d-BHC	g-BHC	Chlor-dane	4,4-DDD	4,4-DDE	4,4-DDT
13	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Typha a	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha b	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha c	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Typha d	<20	<20	<20	<20	<20	<30	<20	<20	<20
	Animals									
	Corbicula	<10	<10	<12	<24	<10	<10	<10	<115	<30
14	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants									
	Scirpus a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

Table II-6 Continued. Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Dieldrin	Endo-sulfan I	Endo- II	Endo- Sulfate	Endrin Aldehyde	Hepta-chlor	Hepta-chlor Epoxide	Meth-oxy-chlor	Toxa-phene	
1	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<200
	Plants										
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Animals										
	Modiolus R1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<500
	Modiolus R2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<500
2	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<200
	Plants										
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<200
3	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<200
	Plants										
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<200
	Spartina b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<200
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<200
	Salicornia d	<2.0	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<200
4	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<200
	Plants										
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<200
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20

Table II-6 Continued. Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg wet-weight)

Site		Dieldrin	Endo-sulfan I I	Endo-sulfan II	Endo-sulfan Sulfate	Endrin	Endrin Aldehyde	Hepta-chlor	Hepta-chlor Epoxide	Meth-oxy-chlor	Toxa-phene
5	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants										
	Spartina a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
7	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	3.6	<3.0	<3.0
	Plants										
	Spartina a	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Spartina b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Salicornia c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Salicornia d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
8	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants										
	Salicornia a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Animals										
	Cerithidea? 1	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Cerithidea? 2	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
9	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants										
	Scirpus a	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Scirpus b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Scirpus c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Scirpus d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20

Table II-6 Concluded. Pesticide Concentration in Naturally-occurring Wetland Plants and Soils (Concentration in ug/kg Wet Weight)

Site		Dieldrin	Endo-sulfan I I	Endo-sulfan II	Sulfate	Endrin	Endrin Aldehyde	Hepta-chlor	Hepta-chlor Epoxide	Met-oxy-chlor	Toxa-phene
10	Soil	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	Plants										
	Typha a	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Typha b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Typha c	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Typha d	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
11	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants										
	Scirpus a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus b	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Scirpus d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
13	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	Plants										
	Typha a										
	Typha b	<20	<20	<20	<20	<20	<30	<20	<20	<20	<20
	Typha c										
	Typha d	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
	Animals										
	Corbicula	16	<10	<10	<10	18	<10	42	<10	<10	
14	Soil	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	
	Plants										
	Scirpus a	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
	Salicornia c	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
	Salicornia d	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	

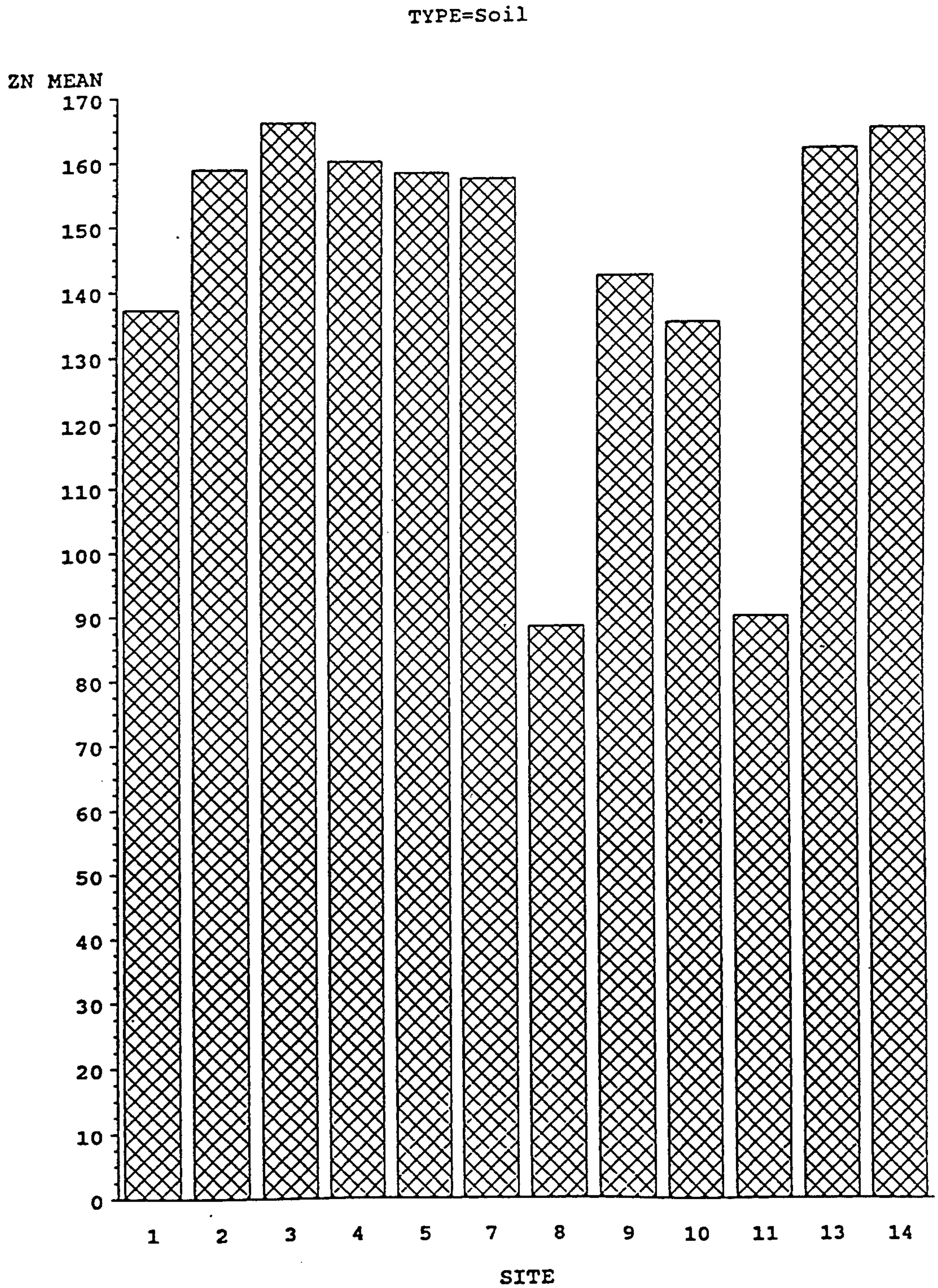

Figure II-17. Mean Zinc Concentrations in Soil from Sites 1 through 14.

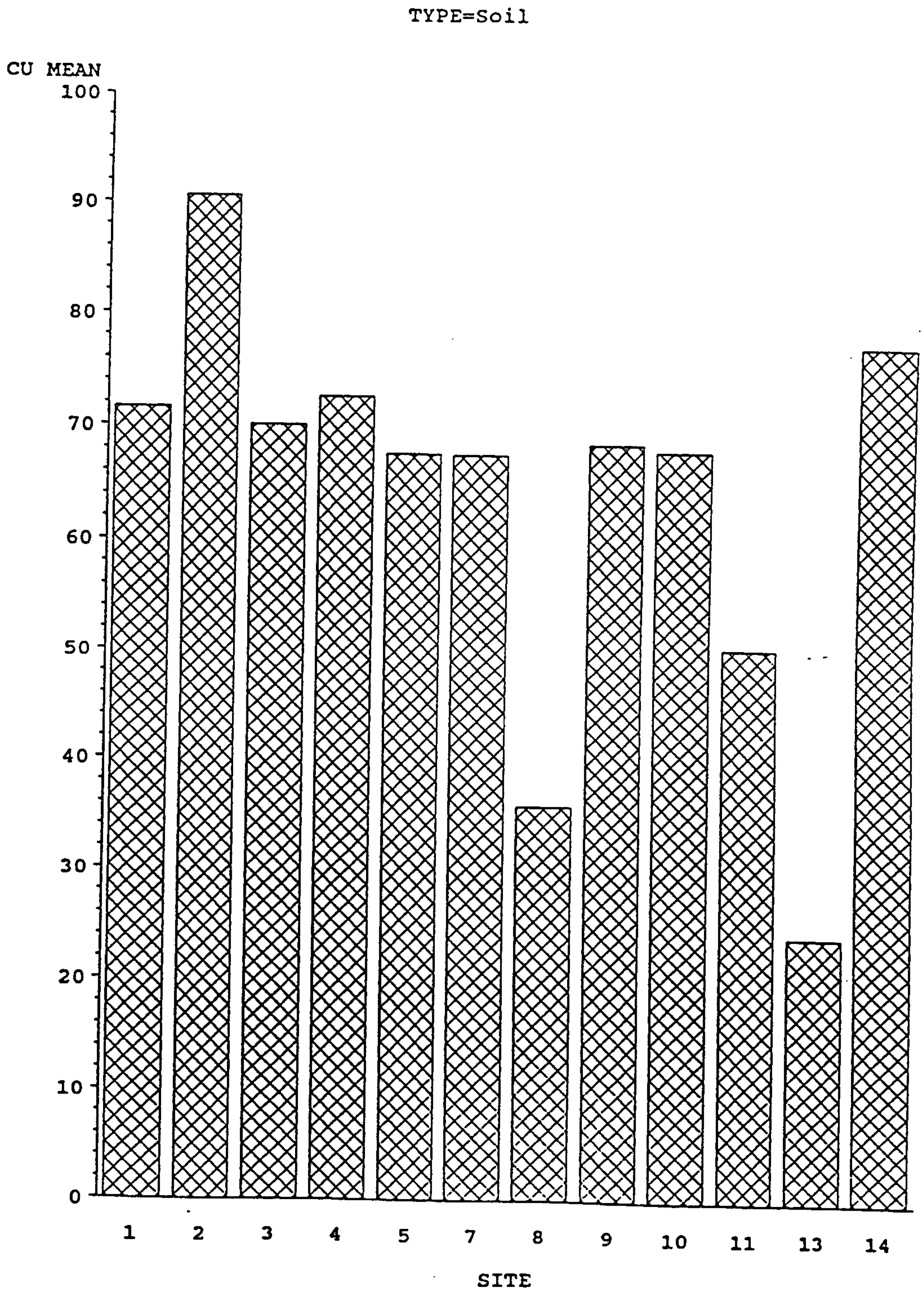

Figure II-18. Mean Copper Concentrations in Soil from Sites 1 through 14.

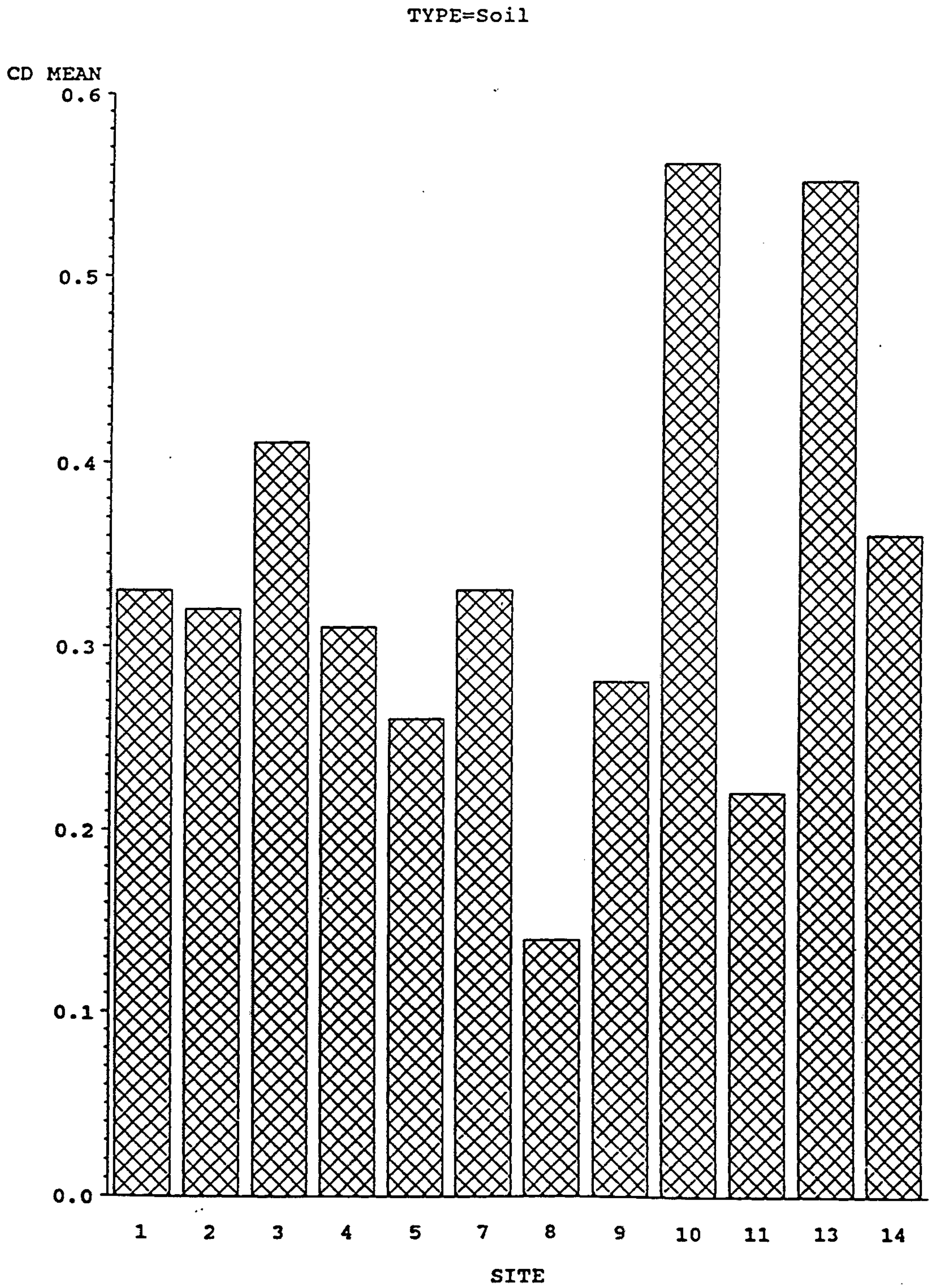

Figure II-19. Mean Cadmium Concentrations in Soil from Sites 1 through 14.

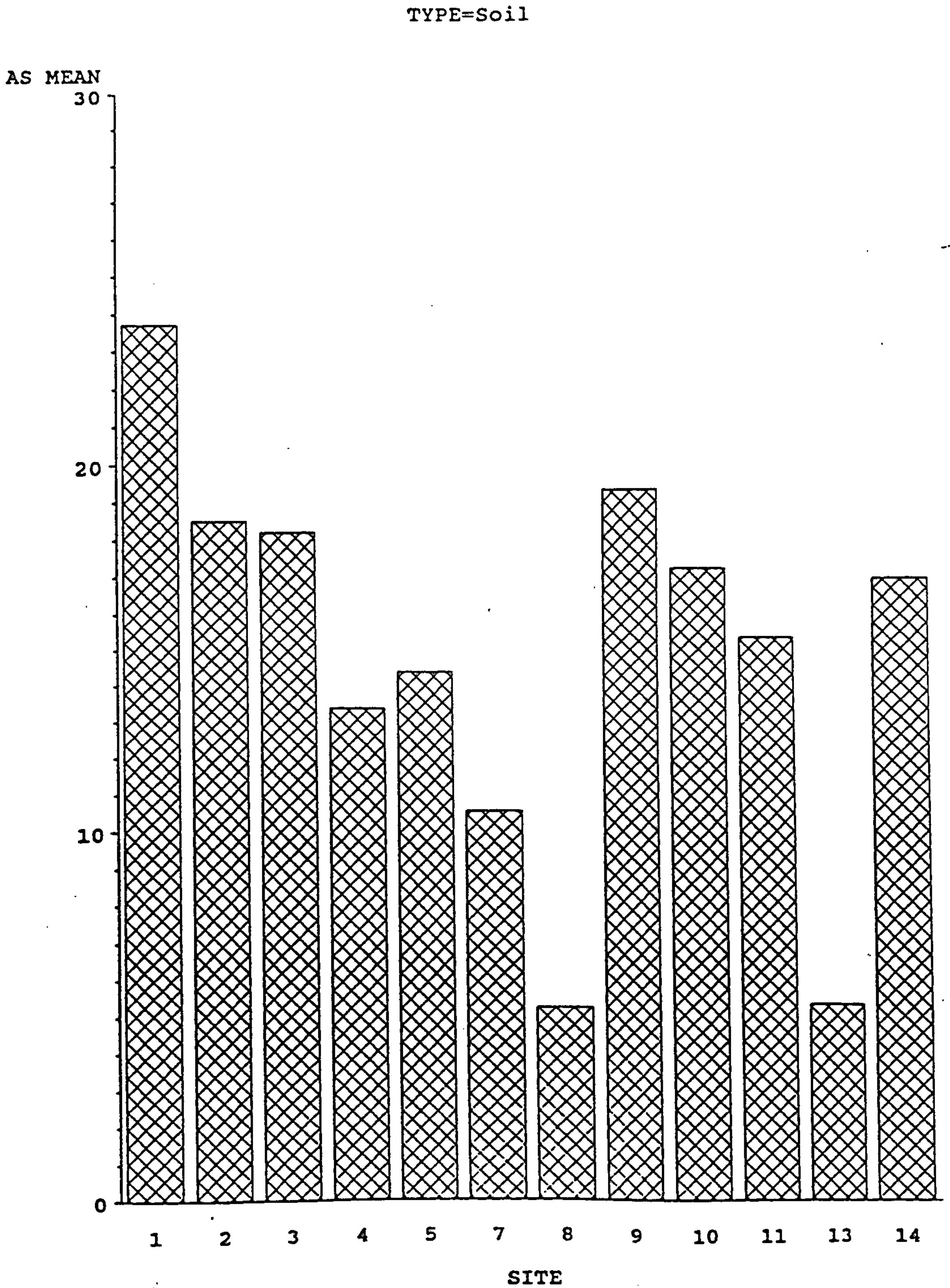

Figure II-20. Mean Arsenic Concentrations in Soil from Sites 1 through 14.

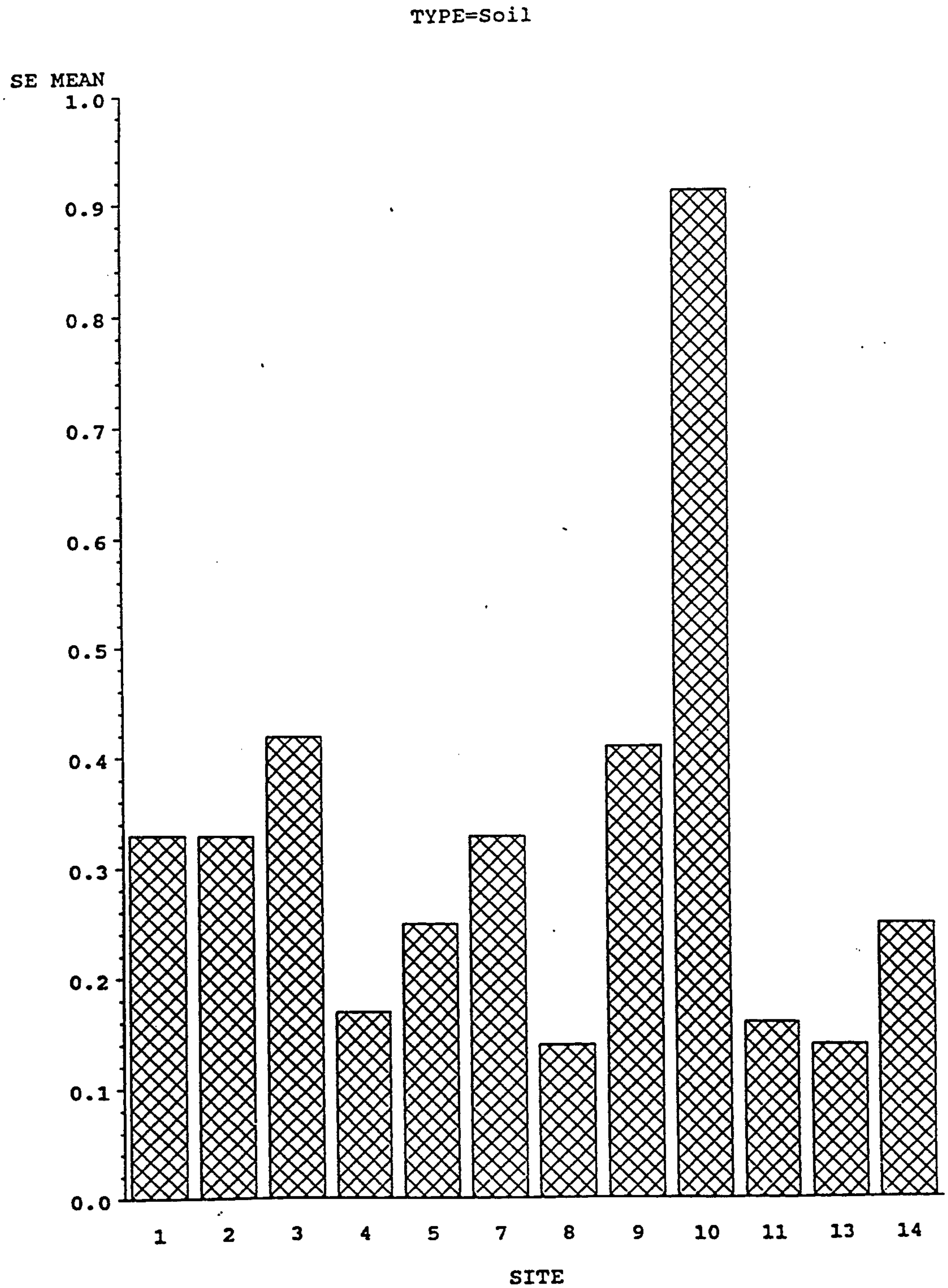

Figure II-21. Mean Selenium Concentrations in Soil from Sites 1 through 14.

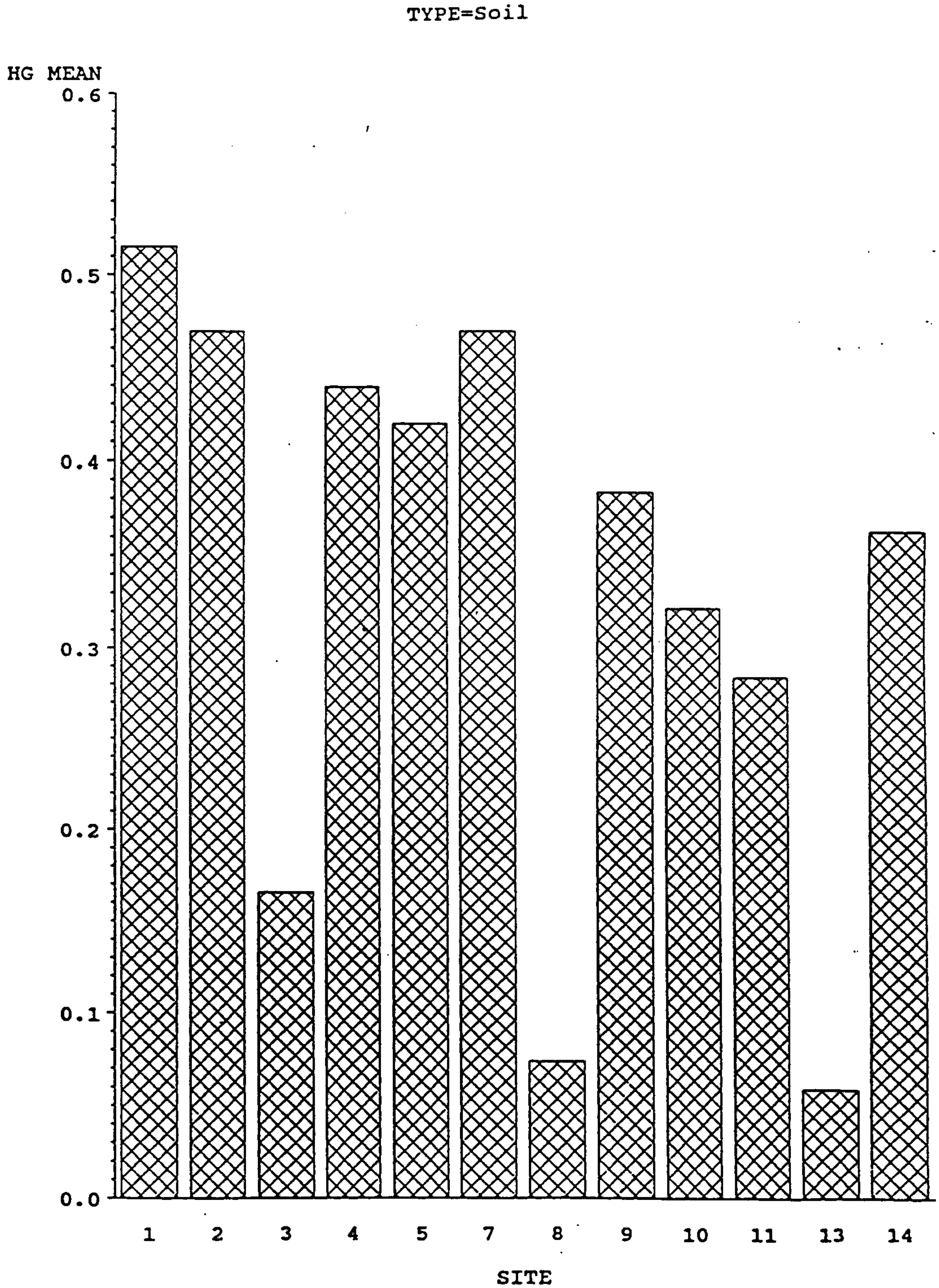

Figure II-22. Mean Mercury Concentrations in Soil from Sites 1 through 14.

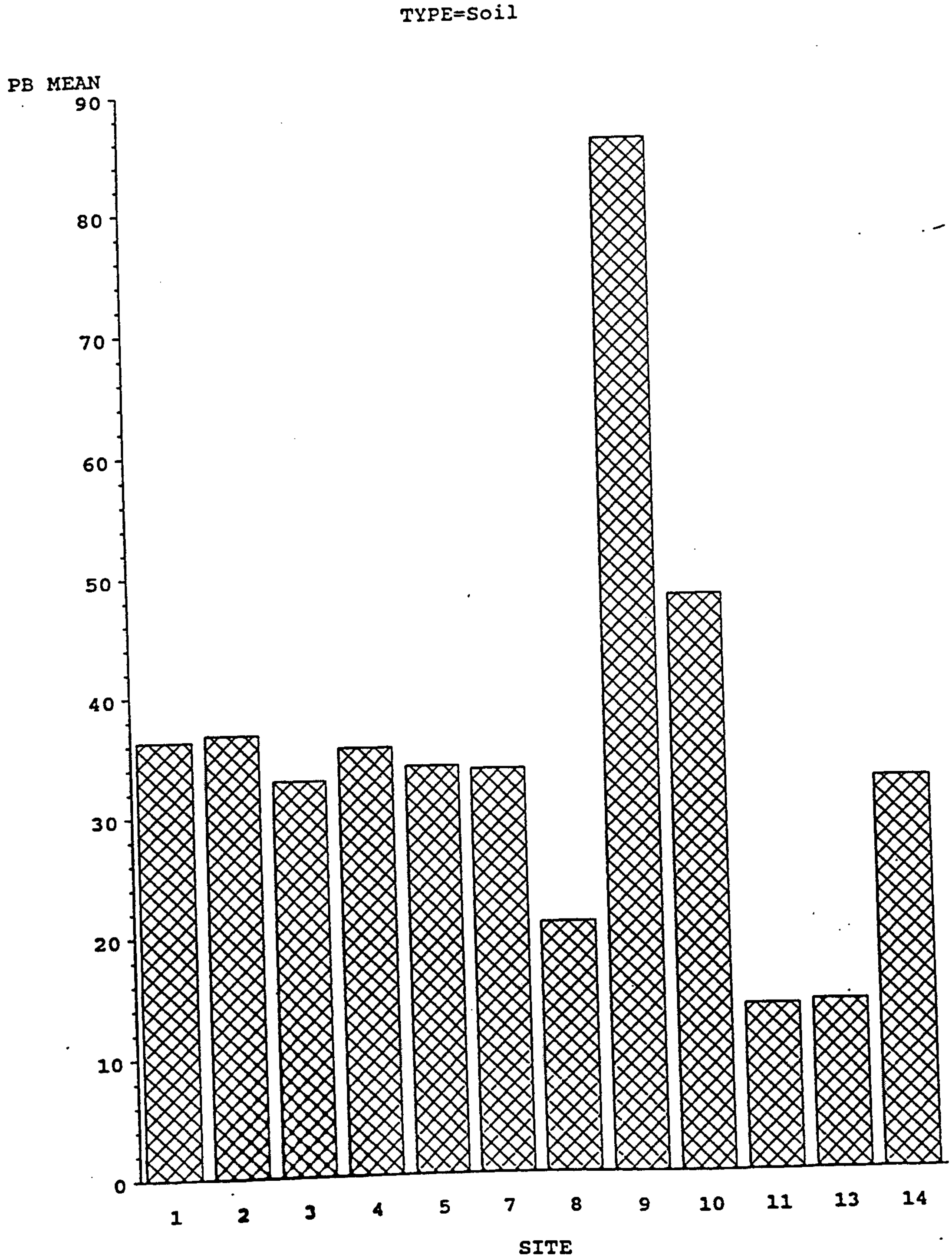

Figure II-23. Mean Lead Concentrations in Soil from Sites 1 through 14.

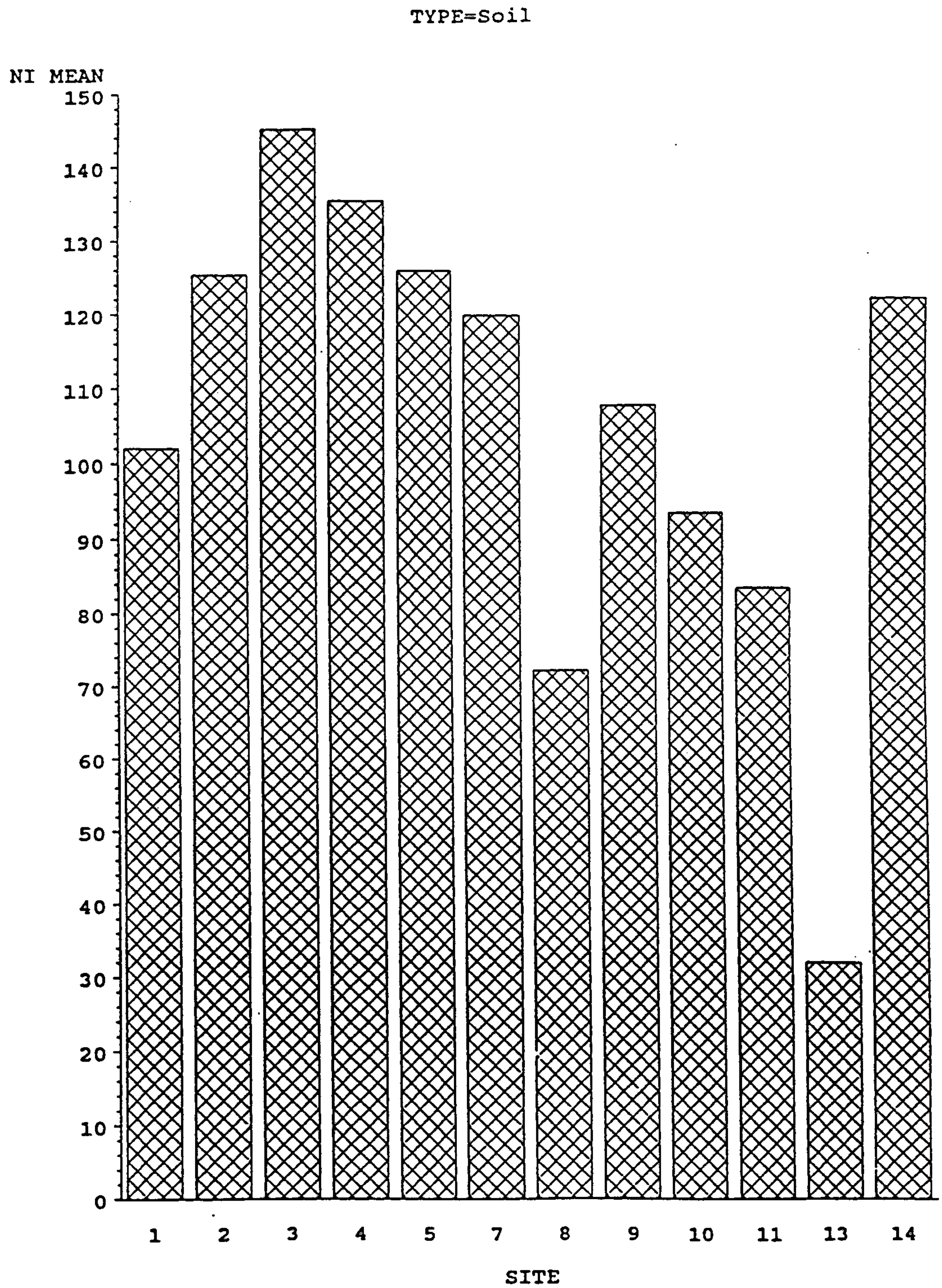

Figure II-24. Mean Nickel Concentrations in Soil from Sites 1 through 14.

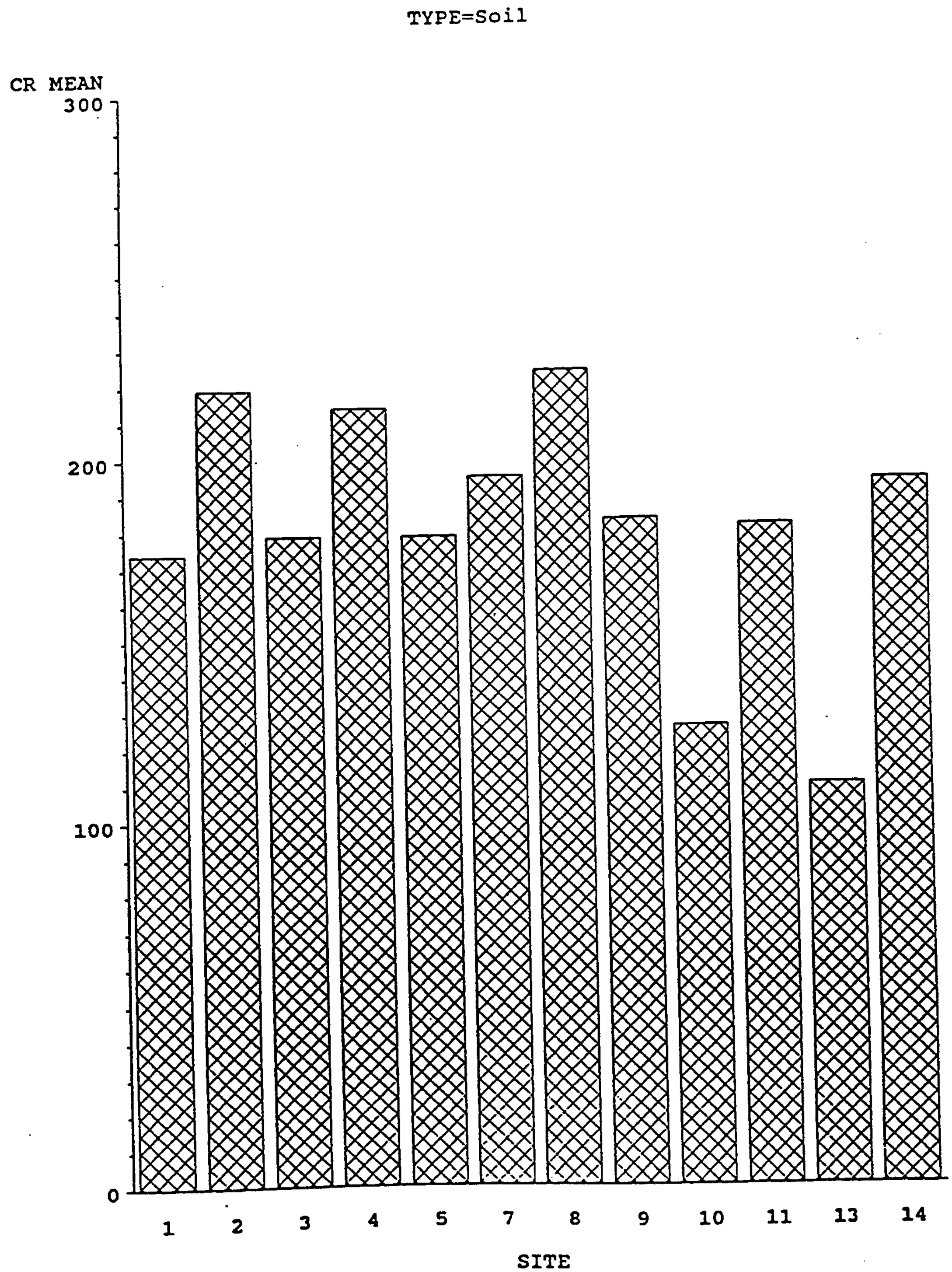

Figure II-25. Mean Chromium Concentrations in Soil from Sites 1 through 14.

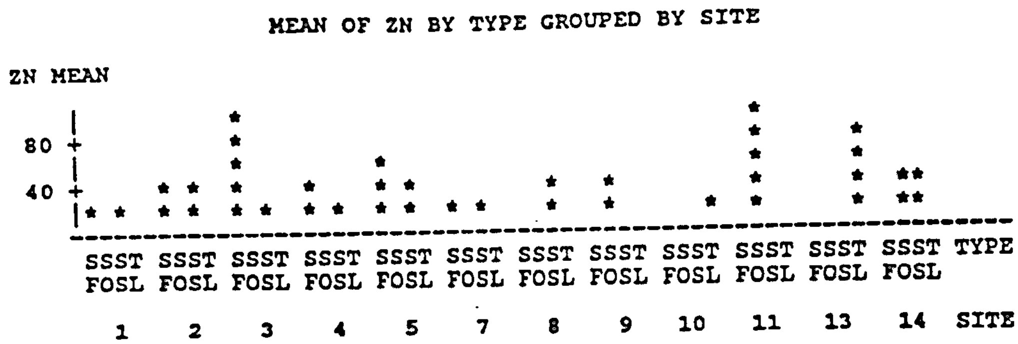

Figure II-26. Mean Zinc Concentrations of Plants, *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

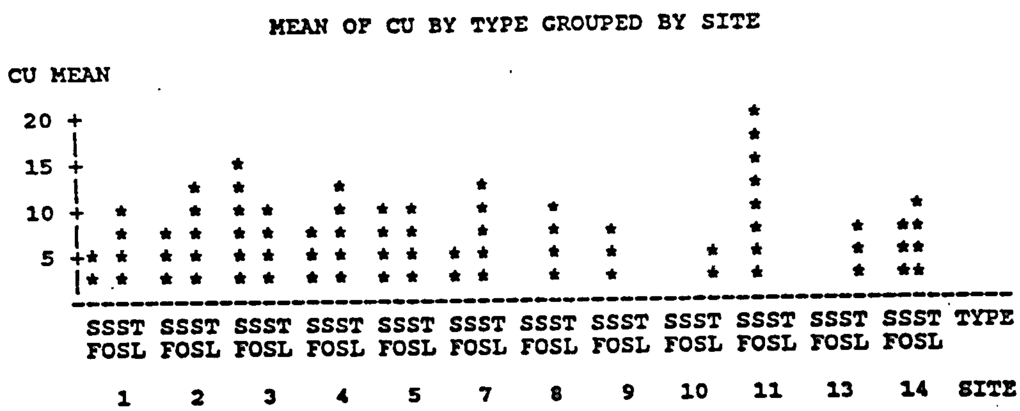

Figure II-27. Mean Copper Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

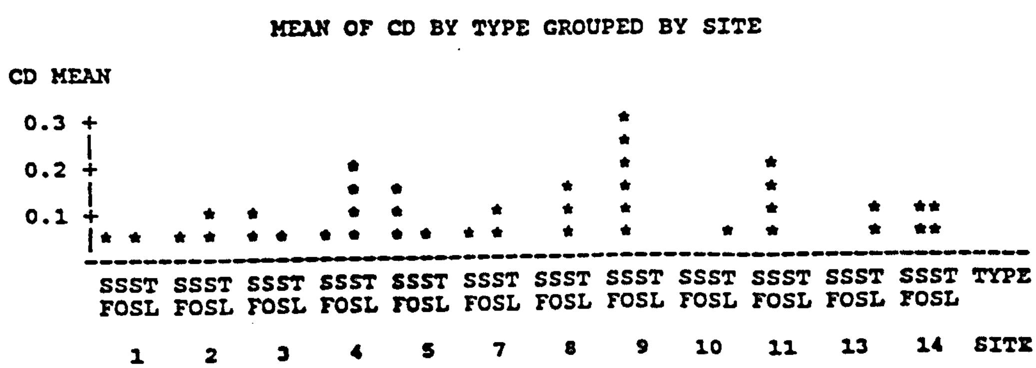

Figure II-28. Mean Cadmium Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

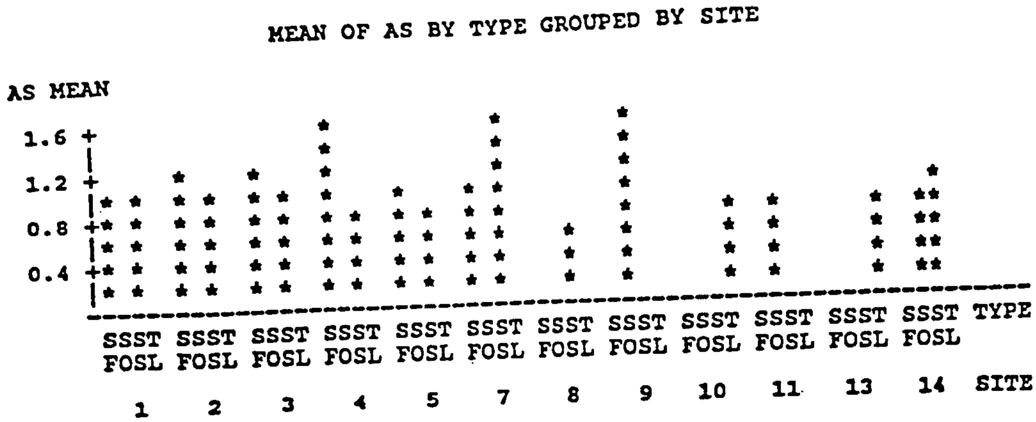

Figure II-29. Mean Arsenic Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

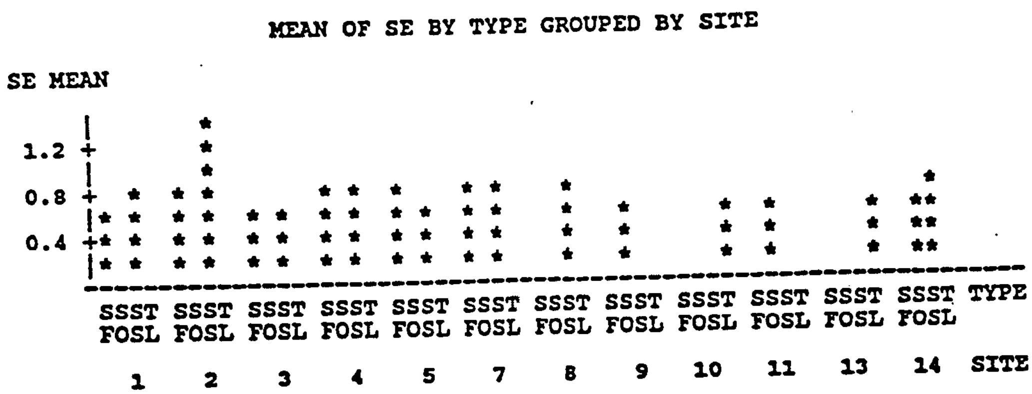

Figure II-30. Mean Selenium Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

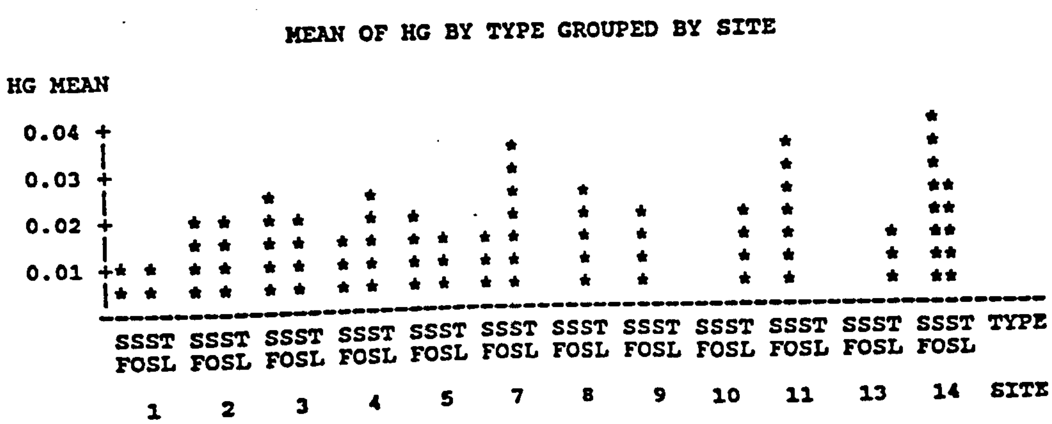

Figure II-31. Mean Mercury Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

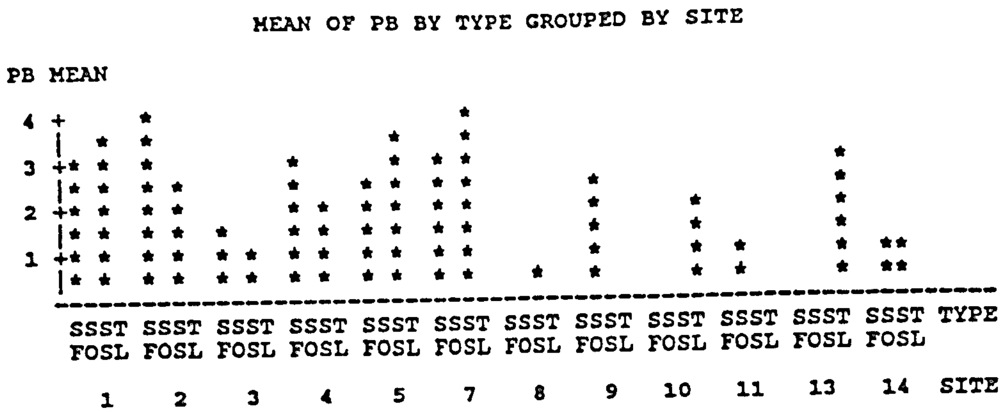

Figure II-32. Mean Lead Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

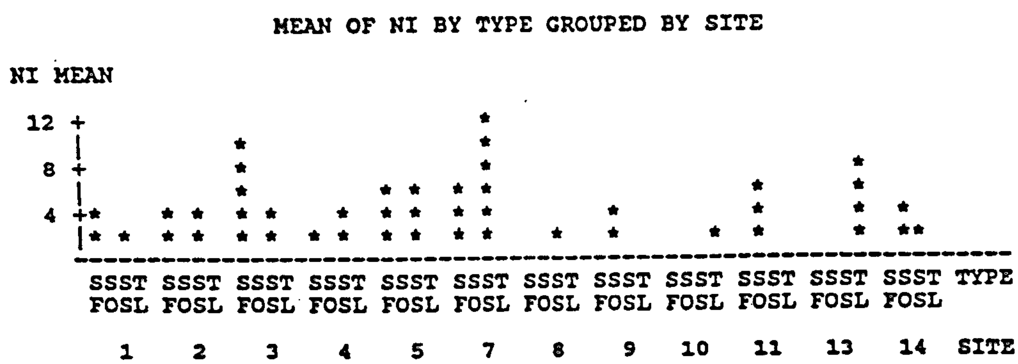

Figure II-33. Mean Nickel Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

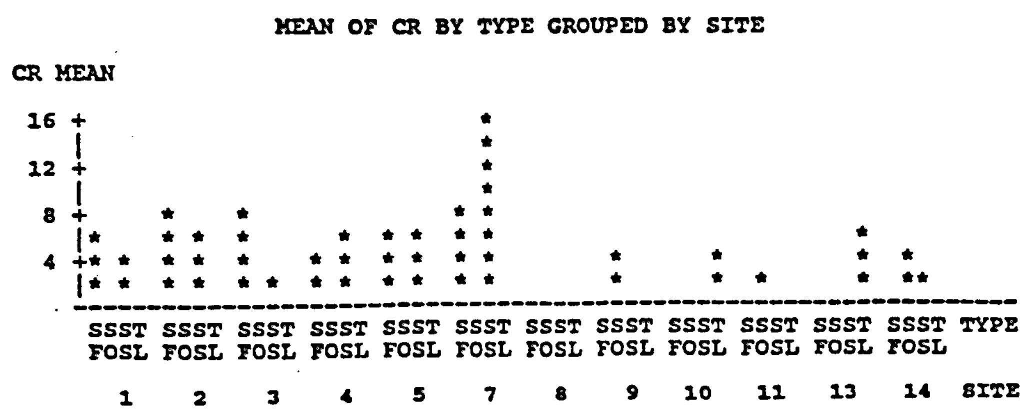

Figure II-34. Mean Chromium Concentrations of Plants *Spartina* (SF), *Salicornia* (SO), *Scirpus* (SS), and *Typha* (TL) Grouped by Site.

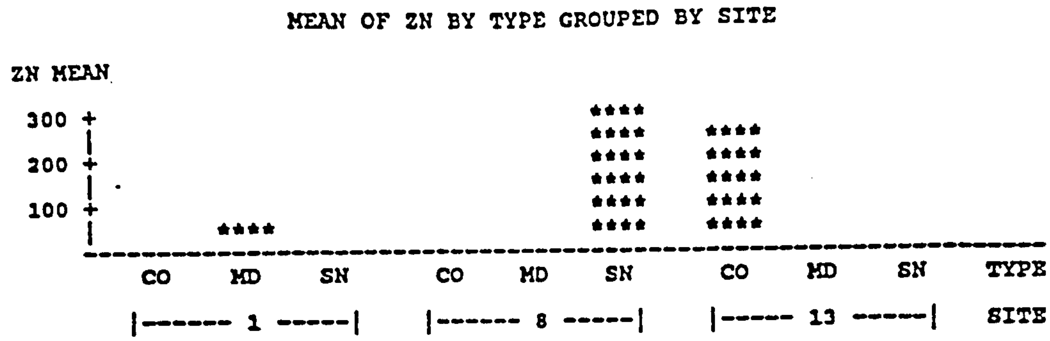

Figure II-35. Mean Zinc Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

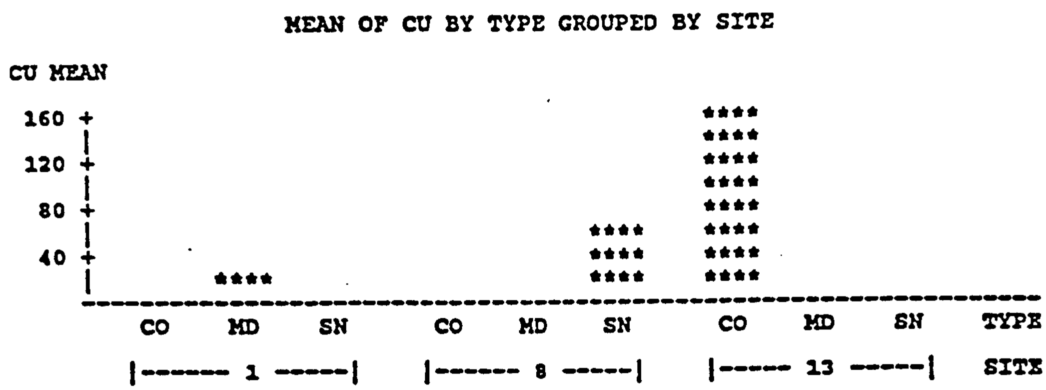

Figure II-36. Mean Copper Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

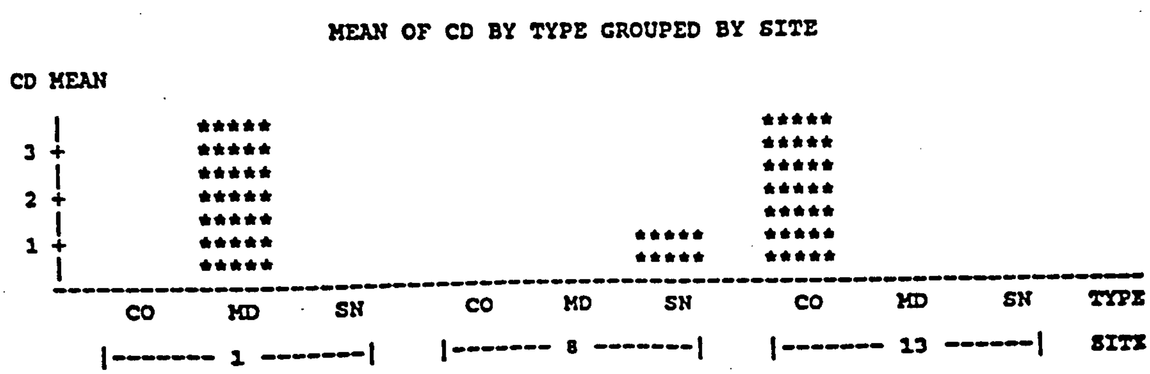

Figure II-37. Mean Chromium Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

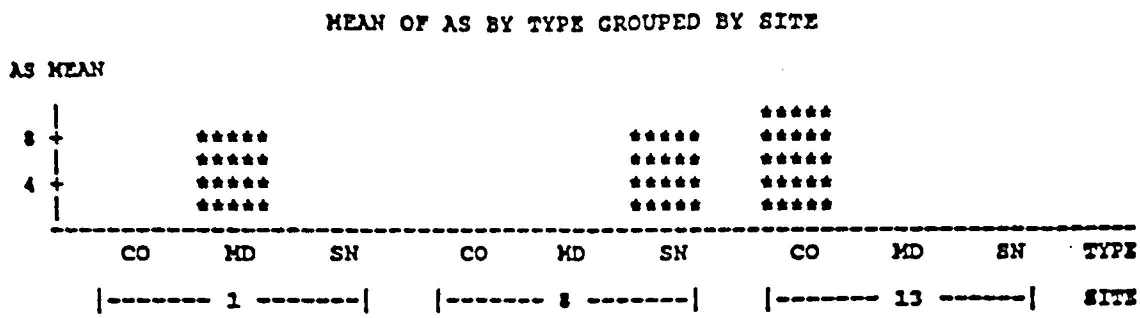

Figure II-38. Mean Arsenic Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

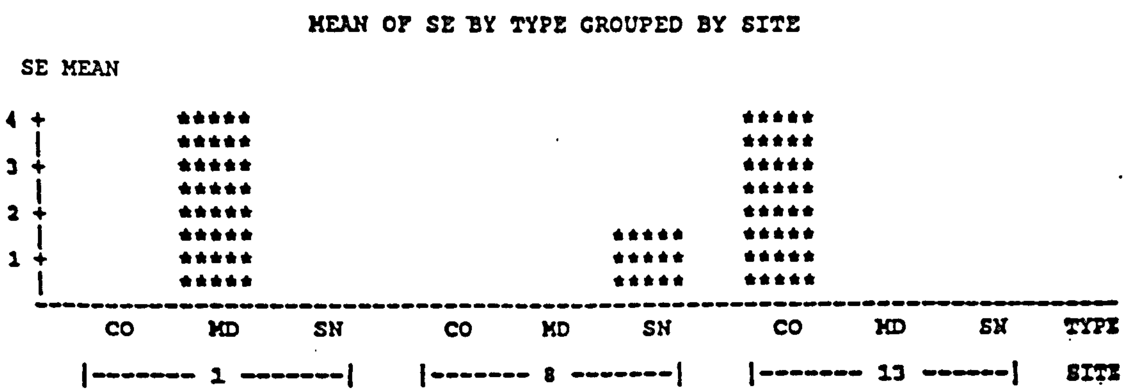

Figure II-39. Mean Selenium Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

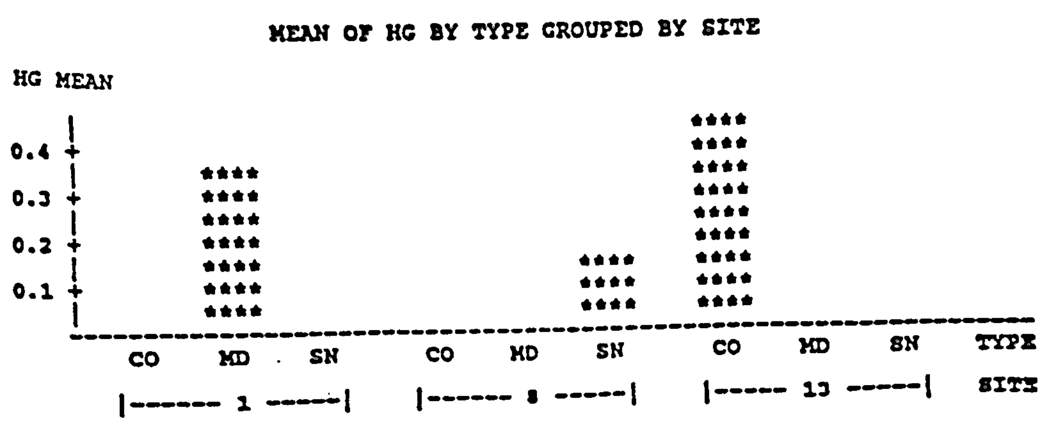

Figure II-40. Mean Mercury Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

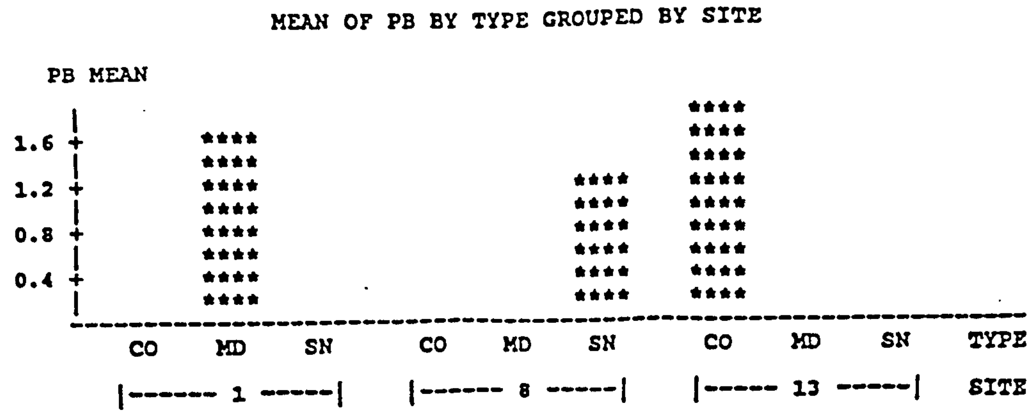

Figure II-41. Mean Lead Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

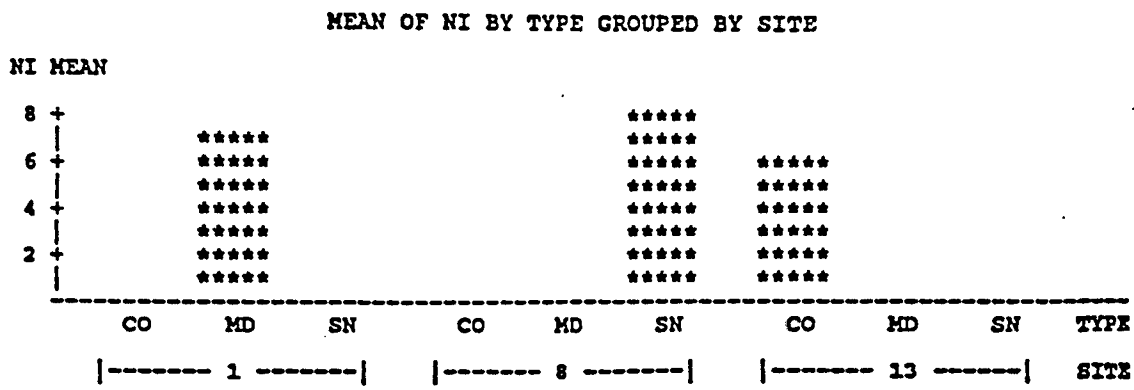

Figure II-42. Mean Nickel Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

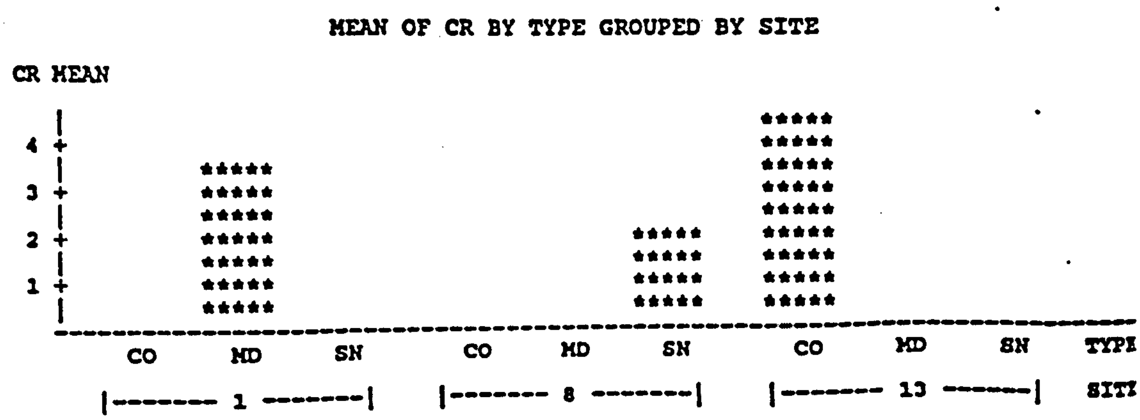

Figure II-43. Mean Chromium Concentrations of Organisms *Corbicula* (CO), *Modiolus* (MD), *Nassarius* (SN) Grouped by site.

Table II-7 Summary of Concentrations of Contaminants in Soils Under Field Conditions (Concentrations in mg/kg, dry-weight for metals, and ug/kg, wet-weight all others)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Metals						
As	14.87	5.29 - 23.7	18.5	16.9 - 19.3	10.3	5.3 - 15.3
Cr	197.7	174.0 - 224.0	167.5	126.0 - 193.0	145.5	110.0 - 181.0
Cu	68.6	35.9 - 90.6	71.5	67.9 - 77.3	37.3	24.2 - 50.3
Ni	120.8	72.2 - 145.2	107.4	93.3 - 122.1	57.8	32.2 - 83.3
Pb	32.9	20.9 - 36.8	62.6	32.5 - 85.6	13.9	13.7 - 14.0
Se	0.28*	<0.14 - 0.42	0.49	0.25 - 0.91	0.15*	<0.14 - 0.16
Zn	146.67	88.5 - 166.1	146.9	135.0 - 164.7	125.8	89.8 - 161.7
Cd	0.30	0.33 - 0.41	0.37	0.28 - 0.56	0.39	0.22 - 0.55
Hg	0.364	0.074 - 0.515	0.365	0.321 - 0.394	0.171	0.059 - 0.283
Butyltins						
Tetrabutyltin	1.76*	<1.2 - 2.9	1.6*	<1.3 - <1.9	<0.9$	<0.9@
Tributyltin	2.57	2.0 - 3.1	3.4	3.2 - 3.6	17.6	1.8 - 33.4
Dibutyltin	3.01*	<1.4 - 89.6	4.3*	<1.6 - 9.6	<0.9$	<0.9@
Monobutyltin	3.83*	<1.3 - 17.0	3.1	2.1 - 4.7	<0.9$	<0.9@
PCBs						
Aroclor 1016	<30$	<30@	<36.7$	<30 - <50	<30$	<30@
Aroclor 1221	<30$	<30@	<36.7$	<30 - <50	<30$	<30@
Aroclor 1232	<30$	<30@	<36.7$	<30 - <50	<30$	<30@
Aroclor 1242	<30$	<30@	<36.7$	<30 - <50	<30$	<30@
Aroclor 1248	<30$	<30@	<36.7$	<30 - <50	<30$	<30@
Aroclor 1254	93.3$	<30 - 210	<36.7$	<30 - <50	<30$	<30@
Aroclor 1260	<30$	<30@	<36.7$	<30 - <50	<30$	<30@

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.

Table II-7 Continued. Summary of Concentrations of Contaminants in Soils Under Field Conditions (Concentrations in ug/kg, wet-weight basis).

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PAHs						
Acenaphthene	10.3*	<10 - 12	13.0*	<10 - 19	<10$	<10@
Acenaphthylene	10.7*	<10 - 15	46.7*	<10 - 120	<10$	<10@
Anthracene	16.3*	<10 - 38	41.3*	<10 - 97	<10$	<10@
Benzo [a] Anthracene	42.4*	<10 - 100	72.3	11 - 150	19.5*	<10 - 29
Benzo [b] Fluoranthene	52.6*	<10 - 96	104.0	18 - 211	14*	<10 - 18
Benzo [k] Fluoranthene	42.1*	<10 - 82	76.7	13 - 150	15*	<10 - 20
Benzo [a] Pyrene	59.9*	130 - <10	69.3	16 - 130	16*	<10 - 22
Benzo [g,h,i] perylene	63.4*	<10 - 110	13.0*	<10 - 19	<10$	<10@
Chrysene	46.7*	<10 - 100	46.7*	<10 - 120	<10$	<10@
Dibenzo [a,h] anthracene	12.1*	<10 - 19	41.3*	<10 - 97	<10$	<10@
Fluoranthene	85.1*	<10 - 190	72.3	11 - 150	20	11 - 29
Fluorene	<10$	<10@	104.0	18 - 211	18	18*
Ideno-1,2,3-pyrene	55.1*	<10 - 99	76.7	13 - 150	16.5	13 - 20
2-Methyl-Naphthalene	22.0*	<10 - 30	NA	NA	NA	NA
Naphthalene	49.1	26 - 64	69.3	16 - 130	19	16 - 22
Phenanthrene	37.4*	<10 - 94	15.0*	<10 - 20	16.5	13 - 20
Pyrene	108.9*	<10 - 240	28.0*	<10 - 46	39.5	33 - 46

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA: Not available.

Table II-7 Concluded. Summary of Concentrations of Contaminants in Soils Under Field Conditions (Concentrations in ug/kg, wet-weight basis)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
Aldrin	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
a-BHC	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
b-BHC	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
d-BHC	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
g-BHC	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Chlordane	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
4,4-DDD	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
4,4-DDE	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
4,4-DDT	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Dieldrin	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Endosulfan I	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Endosulfan II	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Endosulfan sulfate	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Endrin	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Endrin Aldehyde	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Heptachlor	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Heptachlor Epoxide	3.09*	3.6 - <3.0	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Methoxychlor	<3.0$	<3.0@	<3.7$	<3.0 - <5.0	<3.0$	<3.0@
Toxaphene	<115.6$	<200 - <3.0	<4.0$	<3.0 - <5.0	<3.0$	<3.0@

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.

Table II-8 Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, dry-weight basis)

		Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
		Mean	Range	Mean	Range	Mean	Range
Metals							
As:	*Spartina*	1.14*	<0.86 - 1.82	NA	NA	NA	NA
	Salicornia	0.91*	<0.003 - 2.20	<0.94$	<0.92 - <0.95	NA	NA
	Scirpus	NA	NA	<1.46$	<0.71 - <4.2	0.85*	0.79 - <0.87
	Typha	NA	NA	<0.81$	<0.77 - <0.87	<0.88$	<0.83 - <0.91
Cr:	*Spartina*	6.65*	2.5 - 8.9	NA	NA	NA	NA
	Salicornia	4.99*	0.4 - 25.4	2.65	1.7 - 3.6	NA	NA
	Scirpus	NA	NA	4.34*	3.3 - 6.4	2.33	0.7 - 4.0
	Typha	NA	NA	<3.65$	<3.4 - <4.1	5.83*	<4.0 - 8.0
Cu:	*Spartina*	8.05	4.35 - 13.9	NA	NA	NA	NA
	Salicornia	10.7	6.52 - 19.1	10.75	10.1 - 11.4	NA	NA
	Scirpus	NA	NA	7.36	5.52 - 10.13	19.4	13.6 - 31.1
	Typha	NA	NA	6.14	4.06 - 10.18	6.53	4.0 - 9.41
Ni:	*Spartina*	5.20	1.96 - 9.29	NA	NA	NA	NA
	Salicornia	4.45*	<0.93 - 19.20	2.82	1.85 - 3.78	NA	NA
	Scirpus	NA	NA	3.93	1.97 - 4.26	6.59	4.47 - 9.39
	Typha	NA	NA	2.41	2.16 - 2.64	5.35	4.27 - 9.40
Pb:	*Spartina*	2.81*	0.60 - 4.90	NA	NA	NA	NA
	Salicornia	2.07*	0.23 - 5.40	0.85	0.71 - 0.99	NA	NA
	Scirpus	NA	NA	2.04*	1.18 - 2.50	0.79	0.49 - 1.03
	Typha	NA	NA	2.05*	<1.9 - 2.19	2.8*	<2.1 - 4.0
Se:	*Spartina*	0.73*	<0.63 - 0.85	NA	NA	NA	NA
	Salicornia	<0.82$	<0.63 - <2.20$	<0.70 -	<0.71	NA	NA
	Scirpus	NA	NA	<0.61$	<0.58 - <0.65	<0.61$	<0.56 - <0.6
	Typha	NA	NA	<0.65$	<0.63 - <0.69	<0.63$	<0.62 - <0.6
Zn:	*Spartina*	45.7	21.2 - 98.0	NA	NA	NA	NA
	Salicornia	30.6	12.04 - 57.4	30.3	29.8 - 30.8	NA	NA
	Scirpus	NA	NA	40.1	27.2 - 48.4	92.7	59.3 - 133.
	Typha	NA	NA	19.2	17.8 - 19.0	71.9	34.3 - 98.8
Cd:	*Spartina*	0.076	0.032 - 0.22	NA	NA	NA	NA
	Salicornia	0.109	0.05 - 0.29	0.12	0.07 - 0.17	NA	NA
	Scirpus	NA	NA	0.24	0.08 - 0.37	0.18	0.13 - 0.24
	Typha	NA	NA	0.064	0.035 - 0.100	0.11	0.07 - 0.14
Hg:	*Spartina*	0.016	0.008 - 0.027	NA	NA	NA	NA
	Salicornia	0.022	0.01 - 0.038	0.027	0.019 - 0.034	NA	NA
	Scirpus	NA	NA	0.024	0.012 - 0.038	0.035	0.018 - 0.0
	Typha	NA	NA	0.019	0.012 - 0.026	0.014	0.010 - 0.0

* : This mean contains at least one less than value.
● : Every variable in this set was this same value.
$: All values were less than detection limits.
NA: Not applicable. No plants of this species at this site.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Butyltins						
Tetrabutyltin:						
Spartina	3.24*	<2.1 - 2.7	NA	NA	NA	NA
Salicornia	6.65*	<1.6 - 54.7	2.75*	<3.1 - 2.4	NA	NA
Scirpus	NA	NA	3.88*	1.2 - 6.1	3.93*	1.2 - 5.5
Typha	NA	NA	8.7^	2.2 - 11.4	12.33*^	<3.2 - 18.3
Tributyltin:						
Spartina	4.82*	<2.5 - 9.2	NA	NA	NA	NA
Salicornia	7.51*^	<1.8 - 35.8	4.6	4.4 - 4.8	NA	NA
Scirpus	NA	NA	8.02^	2.2 - 14.7	4.97	2.2 - 5.6
Typha	NA	NA	4.13^	2.2 - 5.7	5.78*^	<3.6 - 8.4
Dibutyltin:						
Spartina	3.07*	<2.1 - 3.7	NA	NA	NA	NA
Salicornia	5.18*	<1.4 - 13.2	2.6*	<3.0 - 2.2	NA	NA
Scirpus	NA	NA	3.78*	<2.9 - 6.7	3.43*	1.1 - 5.6
Typha	NA	NA	3.0^	2.5 - 3.7	3.45*^	2.3 - 4.4
Monobutyltin:						
Spartina	4.78*	<1.9 - 19.8	NA	NA	NA	NA
Salicornia	15.6*	<1.3 - 64.3	20.35	5.6 - 35.1	NA	NA
Scirpus	NA	NA	4.2*	<2.9 - 5.0	5.87*^	<3.7 - 9.5
Typha	NA	NA	7.45*^	<2.2 - 14.0	4.7*^	<3.0 - 7.0
PCBs						
Aroclor 1016						
Spartina	<73.3$	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0$	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100$	<100@	<20$	<20@
Typha	NA	NA	<100$	<100@	<100$	<100@
Aroclor 1221						
Spartina	<73.3$	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0$	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100$	<100@	<20$	<20@
Typha	NA	NA	<100$	<100@	<100$	<100@
Aroclor 1232						
Spartina	<73.3$	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0$	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100$	<100@	<20$	<20@
Typha	NA	NA	<100$	<100@	<100$	<100@

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
^ : Indicates analyte detected in the blank.
NA: Not applicable. No plants of this species at these sites.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PCBs						
Aroclor 1242						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<55.0[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1248						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1254						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
Aroclor 1260						
Spartina	<73.3[$]	<20 - <100	NA	NA	NA	NA
Salicornia	<60[$]	<20 - <100	NA	NA	NA	NA
Scirpus	NA	NA	<100[$]	<100[@]	<20[$]	<20[@]
Typha	NA	NA	<100[$]	<100[@]	<100[$]	<100[@]
PAHs						
Acenaphthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Acenaph-thylene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Anthracene						
Spartina	11.3[*]	<10 - 26	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA: Not applicable. No plants of this species at these sites.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PAHs						
Benzo [a] Anthracene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Benzo [b] Fluoranthene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Benzo [b] Fluoranthene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Benzo [k] Fluoranthene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Benzo [a] Pyrene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Benzo [g,h,i] perylene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@
Chrysene						
Spartina	<10$	<10@	NA	NA	NA	NA
Salicornia	<10$	<10@	<10$	<10@	NA	NA
Scirpus	NA	NA	<10$	<10@	<10$	<10@
Typha	NA	NA	<10$	<10@	<10$	<10@

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA: Not applicable/Not available. No plants of this species at these sites.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Dibenzo [a,h] anthracene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Fluoranthene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	10.06[*]	<10 - 11	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Fluorene						
Spartina	10.42[*]	<10 - 15	NA	NA	NA	NA
Salicornia	10.06[*]	<10 - 11	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Indeno-1,2,3-pyrene						
Spartina	<10[$]	<10[@]	NA	NA	NA	NA
Salicornia	<10[$]	<10[@]	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
2-Methyl-Naphthalene						
Spartina	24.83[*]	<20 - 32	NA	NA	NA	NA
Salicornia	24.31[*]	<20 - 37	NA	NA	NA	NA
Scirpus	NA	NA	NA	NA	NA	NA
Typha	NA	NA	NA	NA	NA	NA
Naphthalene						
Spartina	56.17[*]	28 - 88	NA	NA	NA	NA
Salicornia	57.31[*]	16 - 98	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Phenanthrene						
Spartina	20.5[*]	<10 - 31	NA	NA	NA	NA
Salicornia	13.69[*]	<10 - 37	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	14.8[*]	<10 - 18	15	10 - 18
Typha	NA	NA	12.75[*]	<10 - 20	12.5[*]	<10 - 18
Pyrene						
Spartina	10.17[*]	<10 - 12	NA	NA	NA	NA
Salicornia	10.13[*]	<10 - 12	<10[$]	<10[@]	NA	NA
Scirpus	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]
Typha	NA	NA	<10[$]	<10[@]	<10[$]	<10[@]

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits. NA: Not applicable.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
Pesticides	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
Aldrin:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
a-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	11.02[*]	<2.0[#] - 2.3	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
b-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
d-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
g-BHC:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Chlordane:						
Spartina	<20.7[$]	<2.0 - <30	NA	NA	NA	NA
Salicornia	<16[$]	<2.0 - <30	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
4,4-DDD:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
4,4-DDE:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
\# : There was a less than value much higher than this highest actual number.
NA: Not applicable/Not available. No plants of this species in these sites.

Table II-8 Continued. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
4,4-DDT:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Dieldrin:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Endosulfan I:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	11.02^{*}	$<2.0^{\#}$ - 2.3	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Endosulfan II:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Endosulfan sulfate:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Endrin:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$
Endrin Aldehyde:						
Spartina	$<14^{\$}$	<2.0 - <20	NA	NA	NA	NA
Salicornia	$<11^{\$}$	<2.0 - <20	$<2.0^{\$}$	$<2.0^{@}$	NA	NA
Scirpus	NA	NA	$<2.0^{\$}$	$<2.0^{@}$	$<2.0^{\$}$	$<2.0^{@}$
Typha	NA	NA	<20	<20	$<20^{\$}$	$<20^{@}$

@ : Every variable in this set was this same value.
\$: All values were less than detection limits.
NA: Not applicable/Not available. No plants of this species at these sites.

Table II-8 Concluded. Summary of Concentrations of Contaminants in Plants Under Field Conditions (Concentrations in ug/kg, wet-weight)

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
Heptachlor:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Heptachlor Epoxide:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Methoxychlor:						
Spartina	<14[$]	<2.0 - <20	NA	NA	NA	NA
Salicornia	<11[$]	<2.0 - <20	<2.0[$]	<2.0[@]	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]
Toxaphene:						
Spartina	<123.5[$]	<2.0 - <200	NA	NA	NA	NA
Salicornia	<80.75[$]	<2.0 - <200	NA	NA	NA	NA
Scirpus	NA	NA	<2.0[$]	<2.0[@]	<2.0[$]	<2.0[@]
Typha	NA	NA	<20	<20	<20[$]	<20[@]

* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
: In this range there was a less than value much higher than this highest actua value.
NA: Not applicable/Not available. No plants of this species at these sites.

Table II-9 Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in mg/kg metals and ug/kg butyltins)[=]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Metals						
As: *Modiolus*	8.85	8.76 - 8.93	NA	NA	NA	NA
Cerithidea	7.78	2.5 - 11.62	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	10.79	10.79[@]
Cr: *Modiolus*	3.65	3.3 - 4.0	NA	NA	NA	NA
Cerithidea	1.83	1.2 - 2.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	4.3	4.3[@]
Cu: *Modiolus*	21.85	20.5 - 23.1	NA	NA	NA	NA
Cerithidea	63.8	23.5 - 93.6	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	164.1	164.1[@]
Ni: *Modiolus*	6.54	5.33 - 7.74	NA	NA	NA	NA
Cerithidea	7.73	4.5 - 10.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	5.78	5.78[@]
Pb: *Modiolus*	1.55	1.39 - 1.71	NA	NA	NA	NA
Cerithidea	1.22	0.82 - 1.43	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	1.89	1.89[@]
Se: *Modiolus*	3.86	3.52 - 4.19	NA	NA	NA	NA
Cerithidea	1.28	1.04 - 1.47	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	3.98	3.98[@]
Zn: *Modiolus*	71.4	71.1 - 71.7	NA	NA	NA	NA
Cerithidea	280.5	131.4 - 309	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	273.0	273.0[@]
Cd: *Modiolus*	3.49	3.45 - 3.53	NA	NA	NA	NA
Cerithidea	0.80	0.34 - 1.03	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	3.34	3.34[@]
Hg: *Modiolus*	0.351	0.304 - 0.398	NA	NA	NA	NA
Cerithidea	0.136	0.055 - 0.180	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	0.469	0.469[@]
Butyltins						
Tetrabutyltin						
Modiolus	<4.45[\$]	<3.9 - <5.0	NA	NA	NA	NA
Cerithidea	<1.00[\$]	<0.6 - <1.4	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	14.6	14.6[@]
Tributyltin						
Modiolus	36.6	34.9 - 38.3	NA	NA	NA	NA
Cerithidea	2.2	1.4 - 3.5	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	40.7	40.7[@]

= : Dry-weight basis for metals; wet-weight for butyltins.
@ : Every variable in this set was this same value.
\$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.
Note : There were no animals analyzed from the estuarine sites.

Table II-9 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[‾]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Butyltins						
Dibutyltin						
Modiolus	7.15[*]	<5.0 - 9.3	NA	NA	NA	NA
Cerithidea	2.55	0.9 - 4.2	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	30.1	30.1[@]
Monobutyltin						
Modiolus	6.2[*]	<4.6 - 7.8	NA	NA	NA	NA
Cerithidea	1.65	1.6 - 1.7	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	11.8	11.8[@]
PCBs						
Aroclor 1016						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1221						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1232						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1242						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1248						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1254						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]
Aroclor 1260						
Modiolus	<100[$]	<100[@]	NA	NA	NA	NA
Cerithidea	<100[$]	<100[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<100[$]	<100[@]

‾ : Note - there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table II-9 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[=]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
PAHs						
Acenaphthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Acenaphthylene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [a] Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [b] Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [k] Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [a] Pyrene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Benzo [g,h,i] Perylene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]

= : Note; there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table II-9 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[‾]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
PAHs	Mean	Range	Mean	Range	Mean	Range
Chrysene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	10.5[*]	<10 - 11	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Dibenzo [a,h] Anthracene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Fluoranthene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Fluorene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Indeno-1,2,3-pyrene						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
2-Methyl-Naphthalene						
Modiolus	37.5[*]	<30 - 45	NA	NA	NA	NA
Cerithidea	<30[$]	<30[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	NA	NA
Naphthalene						
Modiolus	90.5[*]	61 - 120	NA	NA	NA	NA
Cerithidea	<60[$]	<60[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Phenanthrene						
Modiolus	25.5	14 - 37	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Pyrene						
Modiolus	18[*]	<10 - 26	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]

‾ : Note; there were no animals analyzed from the estuarine sites.
* : This mean contains at least one less than value.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table II-9 Continued. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg, wet-weight)[-]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
Pesticides	Mean	Range	Mean	Range	Mean	Range
Aldrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
a-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
b-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<12[$]	<12[@]
d-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<24[$]	<24[@]
g-BHC						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Chlordane						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
4,4-DDD						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
4,4-DDE						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<115[$]	<115[@]
4,4-DDT						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<30[$]	<30[@]
Dieldrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<16[$]	<16[@]

- : Note; there were no animals analyzed from the estuarine sites.
@ : Every variable in this set was this same value.
$: All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

Table II-9 Concluded. Summary of Concentrations of Contaminants in Animals Under Field Conditions (Concentrations in ug/kg wet-weight)[-]

	Marine Sites: 1 - 8		Estuarine Sites: 9, 10, and 14		Freshwater Sites: 11 - 13	
	Mean	Range	Mean	Range	Mean	Range
Pesticides						
Endosulfan I						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endosulfan II						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endosulfan Sulfate						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Endrin						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	18[$]	18[@]
Endrin Aldehyde						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Heptachlor						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	42[$]	42[@]
Heptachlor Epoxide						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Methoxychlor						
Modiolus	<10[$]	<10[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	<10[$]	<10[@]
Toxaphene						
Modiolus	<500[$]	<500[@]	NA	NA	NA	NA
Cerithidea	<10[$]	<10[@]	NA	NA	NA	NA
Corbicula	NA	NA	NA	NA	NA	NA

[-] : Note; there were no animals analyzed from the estuarine sites.
[@] : Every variable in this set was this same value.
[$] : All values were less than detection limits.
NA : Not applicable/Not available. No animals of this species at this site.

III. CONCLUSIONS AND RECOMMENDATIONS

The naturally-occurring wetlands in the San Francisco Bay area and the adjacent estuarine and fresh water areas appear to contain relatively low levels of most metal, PCB, PAH, butyltin, and pesticide contaminants in soil/sediment, plants, and animals. Metals such as lead, chromium and arsenic appeared to have elevated concentrations in some plants and animals. There is, however, a very depauperate faunal component in all the naturally occurring wetlands surveyed, that may be the result of a more subtle impact. The introduction and proliferation of a tiny exotic clam from Asia, Potamocorbula amurensis may be a contributing factor. This species out-competes and is a more efficient feeder than existing species. In the brackish and freshwater sites, the clam Corbicula was represented also by many shells and only a few live animals. The invasion of Potamocorbula amurensis also includes brackish waters such as in Suisun Bay. Snails were equally scarce on all sites but Site 8. This lack of animals is quite peculiar since the snails, and mussels are invasive species from the U. S. East Coast, and the clams are an equally opportunistic species from Asia. While it is likely that the introduction of the exotic species (Nassarius, Modiolus, and Corbicula) accompanied some disturbance of the California wetlands, these are very hardy species and would have been expected to survive subsequent disturbances. However, Potamocorbula amurensis could even be out-competing these species. This survey was conducted toward the end of a five year drought experienced in the region. This climatic condition no doubt influenced the existing fauna available for sampling. Further documentation of the fauna of the San Francisco Bay area wetlands appears to be warranted. In addition, further evaluation of the status of arsenic, lead and chromium in wetland foodwebs in the San Francisco Bay area.

The data presented in this report establishes an initial baseline for wetlands in the San Francisco Bay Area and can be used to interpret wetland test results for wetland creation or restoration projects. As more information becomes available, this baseline should be updated to include all ongoing and future data collection activities.

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APPENDIX A

Field Survey

Plant and Animal Tissue Concentrations

a. Plant Codes

SPA **Spartina Foliosa**
SCI **Scirpus olynei**
SAL **Salicornia subterminalis**
TYP **Typha latifolia**

b. Animal Codes

SN **Cerithidea ?**
CB **Corbicula fluminea**
MO **Modiolus demissus**

PLANT METAL RESULTS

(Concentrations in mg/kg Dry Weight, ppm)

Battelle Code	Sponsor Code	As	Cr	Cu	Ni	Pb	Se	Zn	Ag	Cd	Hg
245-1	R5B-SPA	1.1 U	5.1 U	8.86	3.29	2.7 U	0.81 U	44.9	0.2	0.22	0.008
245-2	R4B-SPA	1.2 U	6.9 U	6.43	3.24	4.9	0.85 U	25.9	0.13	0.043	0.012
245-3	R7A-SPA	1.1 U	6 U	4.64	4.29	3.6	0.79 U	28.5	0.07	0.043	0.009
245-4,5,6,	R2A-SPA-1,2,3	1.2 U	8.9	6.44	4.61	3.0	0.85 U	30.5	0.14	0.063	0.02
245-7	R1A-SPA	0.96 U	4.7 U	4.63	1.96	4.0	0.74 U	27.6	0.11	0.055	0.006
245-8,9	R2B-SPA-1,2	1.1 U	6.3 U	7.2	4.11	4.7	0.76 U	34.8	0.23	0.066	0.02
245-10	RID-SAL-1	0.94	3.7 U	10.45	2.71	2.4 U	0.70 U	16.6	0.01	0.069	0.012
245-11	RID-SAL-2	0.96 U	3.7 U	11.46	2.68	2.5 U	0.72 U	20.0	0.02	0.093	0.016
245-12,14	RIC-SAL-1,3	1.0 U	4.2	7.92	3.07	4.1	0.77 U	18.0	0.01	0.051	0.01
245-13,15	RIC-SAL-2,4	1.2 U	4.8 U	8.93	2.47	2.9 U	0.87 U	18.5	0.02	0.082	0.017
245-16,18	R2D-SAL-1,3	1.1 U	10.6	13.9	6.07	3.9	0.78 U	31.5	0.03	0.089	0.022
245-17,19	R2D-SAL-2,4	0.96 U	5.2 U	11.7	3.03	4.6	0.74 U	23.2	0.01 U	0.1	0.014
245-20,21	R13C-TYP-1,2	0.87 U	4.2 U	5.12	4.27	2.8	0.62 U	34.3	0.01 U	0.07	0.016
245-22,23	R13B-TYP-1,2	0.9 U	8	7.59	9.40	2.3	0.63 U	93.6	0.01 U	0.14	0.015
245-24,25	R13D-TYP-1,2	0.83 U	4 U	4	8.31	2.1 U	0.62 U	98.8	0.01 U	0.09	0.01
245-26	R13A-TYP	0.91 U	7.1 U	9.41	7.40	4.0	0.66 U	61.0	0.01 U	0.13	0.014
245-27	R10D-TYP	0.87 U	4.1 U	10.18	2.54	2.1 U	0.69 U	21.3	0.03	0.1	0.012
245-28	R10A-TYP	0.79 U	3.4 U	4.06	2.28	2.0 U	0.63 U	19.0	0.01 U	0.035	0.016
245-29	R10C-TYP	0.79 U	3.5 U	5.36	2.64	2.19	0.63 U	18.6	0.02	0.055	0.022
245-30,31	R10B-TYP-1,2	0.77 U	3.6 U	4.95	2.16	1.9 U	0.63 U	17.8	0.02	0.067	0.026
245-32	R7B-SPA	0.99 U	8.9	6.1	7.40	2.7	0.72 U	25.5	0.06	0.064	0.017
245-33	R1B-SPA	0.86 U	7.1	4.35	4.34	2.2	0.64 U	21.2	0.12	0.032	0.015
245-34,35,36 REP 1	R9B-SCI-1,2,3 REP 1	0.82 U	3.9	6.64	7.92	2.50	0.62 U	43.5	0.06	0.37	0.026
245-34,35,36 REP 2	R9B-SCI-1,2,3 REP 2	0.82 U	3.6 U	7.72	9.95	2.1 U	0.63 U	49.2	0.05	0.38	0.024
245-37	R9C-SCI	0.03 U	4.2 U	10.13	2.03	2.50	0.65 U	39.7	0.09	0.35	0.012
245-38,39	R9D-SCI-1,2	0.79 U	3.9	5.52	1.97	2.00 U	0.58 U	27.2	0.04	0.19	0.024
245-40,41,42 REP 1	R9A-SCI-1,2,3 REP 1	0.71 U	6.4	6.83	4.26	2.00 U	0.60 U	41.7	0.05	0.2	0.02
245-40,41,42 REP 2	R9A-SCI-1,2,3 REP 2	0.75 U	4.4	8.4	5.65	2.0 U	0.60 U	41.3	0.05	0.19	0.021
245-43	R7C-SAL-1	1.14	6.6	8.79	5.37	2.30 U	0.69 U	19.5	0.02	0.067	0.011
245-44	R7-SAL-2	0.93 U	5.7 U	8.88	4.04	2.40 U	0.79 U	22.4	0.02	0.14	0.017
245-45	R5C-SAL-1	0.62 U	6.8	8.68	5.66	2.80	0.65 U	15.7	0.02	0.039	0.012
245-46	R5C-SAL-2	1.18	7.9 U	10.5	5.40	2.60 U	0.90 U	45.2	0.01 U	0.083	0.013
245-47	R4D-SAL-1	0.76 U	4.6	6.52	1.66	2.10 U	0.63 U	12.04	0.01	0.094	0.014
245-48	R4D-SAL-2	0.91 U	8	11.09	2.14	2.40 U	0.79 U	30.7	0.02	0.16	0.019
245-49	R7D-SAL-1	2.20	25.4	17.7	19.20	5.40	0.73 U	37.5	0.05	0.1	0.059
245-50	R7D-SAL-2	1.00 U	7.7	8.94	2.96	2.60 U	0.86 U	22.6	0.01 U	0.1	0.016
Procedural Blank		N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.01	0.01 U	0.004 U

U indicates analyte not detected at detection limit shown

N/A indicates not applicable. Note: procedural blanks are not appropriate for XRF analyses.

STANDARD REFERENCE MATERIAL (Concentrations in mg/kg Dry Weight, ppm)

Battelle Code	Sponsor Code	As	Cr	Cu	Ni	Pb *	Se	Zn	Ag	Cd	Hg
SRM 1571 ORCHARD LEAVES, REP 1		11.2	4.3 U	12.7	1.07	45.7	0.77 U	27.8	0.01 U	0.15	0.129
SRM 1571 ORCHARD LEAVES, REP 1A		8.72	4.1 U	12.4	1.57	48.5	0.70 U	26.2	0.01 U	0.16	
SRM 1571 ORCHARD LEAVES, REP 2		10.54	3.6 U	11.68	1.49	43.5	0.60 U	25.1			
SRM 1571 ORCHARD LEAVES, REP 2A		9.97	3.5 U	11.23	1.20	43.3	0.60 U	23.9			
SRM 1571 ORCHARD LEAVES, REP 3		10.1	5	10.75	1.05	43.5	0.59 U	25.8			
	Certified Value:	14 ±2	NC	12 ± 1	1.3 ±0.2	45 ±3	0.08 ±0.01	25 ±3	NC	0.11 ±0.02	0.155 ±0.015
SRM 1566A OYSTER TISSUE (RICHLAND), REP 1		14.43	3.3 U	65.7	2.20	2.9	2.03	872.0	1.28	4.09	0.059
SRM 1566A OYSTER TISSUE (MSL), REP 1		13.59	3.5	68.4	2.05	3.6	2.04	892.0	1.46	4.15	
SRM 1566A OYSTER TISSUE (RICKLAND), REP 2		14.98	4.6	64.7	2.20	2.0 U	2.36	817.0			
SRM 1566A OYSTER TISSUE (MSL), REP 2		14.95	3.1 U	64.7	2.18	2.5	2.02	837.0			
SRM 1566A OYSTER TISSUE (RICHLAND), REP 3		13.35	3.1 U	62.7	2.14	2.1	2.17	845.0			
SRM 1566A OYSTER TISSUE (MSL), REP 3		14.93	3.3 U	64.6	1.85	1.9 U	2.27	884.0			
	Certified Value:	14 ±1.2	1.43 ±0.46	66.6 ± 4.3	2.25 ±0.44	:71 ±0.014*	2.21 ±0.24	830 ±57	1.68 ±0.15	4.15 ±0.38	0.0642 ±.0067

* Lead determined by ICP-MS, not XRF.

PAH RESULTS FOR WES PLANT SAMPLES cl# 245
(Concentrations in ug/Kg Dry Weight, ppb)

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	% Moist.	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo[a] Anthra-cene	Benzo[b] Fluor-anthene	Benzo[k] Fluor-anthene	Benzo[a] pyrene	Benzo-(g,h,i)-perylene
BLANK 1	BLANK 1	3/18/91	4/11/91	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-1	R5B-SPA	3/18/91	4/11/91	86	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-2	R4B-SPA	3/18/91	4/11/91	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-3	R7A-SPA	3/18/91	4/11/91	81	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-4,5,6,	R2A-SPA-1,2,3	3/18/91	4/11/91	80	10 U	10 U	26	10 U	10 U	10 U	10 U	10 U
245-7	R1A-SPA	3/18/91	4/11/91	82	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-8,9	R2B-SPA-1,2	3/18/91	4/11/91	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-10,	RID-SAL-1	3/18/91	4/11/91	73	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-11,	RID-SAL-2	3/18/91	4/11/91	91	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-12,14	RIC-SAL-1,3	3/18/91	4/11/91	72	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-13,15	RIC-SAL-2,4	3/18/91	4/11/91	89	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-16,18	R2D-SAL-1,3	3/18/91	4/11/91	73	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-17,19	R2D-SAL-2,4	3/18/91	4/11/91	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BLANK 2	BLANK 2	11/29/90	12/12/90	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-20,21	R13C-TYP-1,2	11/29/90	12/12/90	86	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-22,23	R13B-TYP-1,2	11/29/90	12/12/90	88	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-24,25	R13D-TYP-1,2	11/29/90	12/12/90	81	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-26	R13A-TYP	12/13/90	12/14/90	90	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-27	R10D-TYP	11/29/90	12/12/90	88	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-28	R10A-TYP	11/29/90	12/12/90	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-29	R10C-TYP	11/29/90	12/12/90	81	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-30,31	R10B-TYP-1,2	11/29/90	12/12/90	82	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-32	R7B-SPA	11/29/90	12/12/90	80	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-33	R1B-SPA	12/13/90	12/14/90	86	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-33, DUP	R1B-SPA, DUP	12/13/90	12/14/90	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/12/90	77	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-37	R9C-SCI	11/29/90	12/13/90	80	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BLANK 3	BLANK 3	11/30/90	12/13/90	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-38,39	R9D-SCI-1,2	11/30/90	12/13/90	82	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-38,39 DUP	R9D-SCI-1,2	11/30/90	12/13/90	NA	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/13/90	75	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-43	R7C-SAL-1	11/30/90	12/13/90	78	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-44	R7-SAL-2	11/30/90	12/13/90	93	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-45	R5C-SAL-1	11/30/90	12/13/90	74	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-46	R5C-SAL-2	11/30/90	12/13/90	89	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-47	R4D-SAL-1	11/30/90	12/13/90	76	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-48	R4D-SAL-2	11/30/90	12/13/90	88	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-49	R7D-SAL-1	11/30/90	12/13/90	80	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
245-50	R7D-SAL-2	11/30/90	12/13/90	89	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

U indicates analyte not detected at detection limit shown
B indicates analyte present in blank associated with that sample (one method blank was run on each date)
NA indicates not applicable

PAH RESULTS FOR WES PLANT SAMPLES
(Concentrations in ug/Kg Dry Weight, ppb)

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	Chrysene	Dibenzo-(a,h)-anthracene	Fluor-anthene	Fluorene	Indeno-1,2,3-Pyrene	2-Methyl-Naphthene	Naph-thalene	Phenan-threne	Pyrene
BLANK 1	BLANK 1	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
245-1	R5B-SPA	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
245-2	R4B-SPA	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	30	63	38	10 U
245-3	R7A-SPA	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	28	54	37	10 U
245-4,5,6,	R2A-SPA-1,2,3	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	21	50 U	30	10 U
245-7	R1A-SPA	3/18/91	4/11/91	10 U	10 U	10 U	15	10 U	29	63	31	10 U
245-8,9	R2B-SPA-1,2	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	32	50 U	20	10 U
245-10	RID-SAL-1	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20 U	50 U	48	10 U
245-11	RID-SAL-2	3/18/91	4/11/91	15	10 U	10 U	10 U	10 U	190	380	130	10 U
245-12,14	RIC-SAL-1,3	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20	50	10	10 U
245-13,15	RIC-SAL-2,4	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20 U	50 U	28	10 U
245-16,18	R2D-SAL-1,3	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	37	98	10 U	10 U
245-17,19	R2D-SAL-2,4	3/18/91	4/11/91	10 U	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
BLANK 2	BLANK 2	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	20 U	20 U	10 U	10 U
245-20,21	R13C-TYP-1,2	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	38	92	18	10 U
245-22,23	R13B-TYP-1,2	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	20 U	42	10 U	10 U
245-24,25	R13D-TYP-1,2	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	20 U	22	10 U	10 U
245-26	R13A-TYP	12/13/90	12/14/90	10 U	10 U	10 U	10 U	10 U	20 U	47	12	10
245-27	R10D-TYP	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	28	65	20	10 U
245-28	R10A-TYP	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	29	63	10 U	10 U
245-29	R10C-TYP	11/29/90	12/12/90	10 U	27	10 U	10 U	10 U	22	51	11	10 U
245-30,31	R10B-TYP-1,2	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	20 U	25	10 U	10 U
245-32	R7B-SPA	11/29/90	12/12/90	10 U	10 U	10 U	10 U	10 U	20 U	28	12	12
245-33	R1B-SPA	12/13/90	12/14/90	10 U	10 U	10 U	10 U	10 U	20 U	42	13	10 U
245-33, DUP	R1B-SPA, DUP	12/13/90	12/14/90	10 U	10 U	16	10 U	10 U	20 U	48	18	19
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/12/90	10 U	10 U	13	10 U	10 U	20 U	18	18	11
245-37	R9C-SCI	11/29/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	20 U	10 U	10 U
BLANK 3	BLANK 3	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10 U	10 U
245-38,39	R9D-SCI-1,2	11/30/90	12/13/90	10 U	10 U	11	10 U	10 U	20 U	30 U	11	10 U
245-38,39 DUP	R9D-SCI-1,2	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10	10 U
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/13/90	10 U	21	22	10 U	10 U	20 U	30 U	17	19
245-43	R7C-SAL-1	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10 U	10 U
245-44	R7-SAL-2	11/30/90	12/13/90	10 U	10 U	13	10 U	10 U	20 U	49	21	13
245-45	R5C-SAL-1	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10 U	10 U
245-46	R5C-SAL-2	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10 U	10 U
245-47	R4D-SAL-1	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	30 U	10 U	10 U
245-48	R4D-SAL-2	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	41	11	10 U
245-49	R7D-SAL-1	11/30/90	12/13/90	10 U	10 U	11	10 U	10 U	20 U	30 U	10 U	12
245-50	R7D-SAL-2	11/30/90	12/13/90	10 U	10 U	10 U	10 U	10 U	20 U	31	11	10 U

U indicates analyte not detected at detection limit shown
B indicates analyte present in blank associated with that sa
NA indicates not applicable

PAH RESULTS FOR WES PLANT SAMPLES

(Concentrations in ug/Kg Dry Weight, ppb)

SURROGATE PERCERNT RECOVERIES

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	Naph- d8	Acen- d10	Phenan- d10?Q	B[a]P- d12	Fluorene- d10	Chrysene- d12
BLANK 1	BLANK 1	3/18/91	4/11/91	98%	NA	NA	NA	56%	110%
245-1	R5B-SPA	3/18/91	4/11/91	36%	NA	NA	NA	35%	37%
245-2	R4B-SPA	3/18/91	4/11/91	110%	NA	NA	NA	120%	110%
245-3	R7A-SPA	3/18/91	4/11/91	79%	NA	NA	NA	100%	85%
245-4,5,6,	R2A-SPA-1,2,3	3/18/91	4/11/91	100%	NA	NA	NA	110%	110%
245-7	R1A-SPA	3/18/91	4/11/91	120%	NA	NA	NA	130%	110%
245-8,9	R2B-SPA-1,2	3/18/91	4/11/91	76%	NA	NA	NA	92%	82%
245-10	RID-SAL-1	3/18/91	4/11/91	110%	NA	NA	NA	130%	130%
245-11	RID-SAL-2	3/18/91	4/11/91	110%	NA	NA	NA	120%	130%
245-12,14	RIC-SAL-1,3	3/18/91	4/11/91	36%	NA	NA	NA	35%	37%
245-13,15	RIC-SAL-2,4	3/18/91	4/11/91	96%	NA	NA	NA	100%	91%
245-16,18	R2D-SAL-1,3	3/18/91	4/11/91	94%	NA	NA	NA	100%	100%
245-17,19	R2D-SAL-2,4	3/18/91	4/11/91	22%	NA	NA	NA	20%	23%
BLANK 2	BLANK 2	11/29/90	12/12/90	30 %	50 %	73 %	120 %		
245-20,21	R13C-TYP-1,2	11/29/90	12/12/90	72 %	83 %	78 %	120 %		
245-22,23	R13B-TYP-1,2	11/29/90	12/12/90	73 %	85 %	80 %	120 %		
245-24,25	R13D-TYP-1,2	11/29/90	12/12/90	84 %	97 %	91 %	136 %		
245-26	R13A-TYP	12/13/90	12/14/90	52 %	63 %	62 %	91 %		
245-27	R10D-TYP	11/29/90	12/12/90	78 %	90 %	81 %	130 %		
245-28	R10A-TYP	11/29/90	12/12/90	60 %	68 %	63 %	95 %		
245-29	R10C-TYP	11/29/90	12/12/90	75 %	87 %	79 %	125 %		
245-30,31	R10B-TYP-1,2	11/29/90	12/12/90	69 %	83 %	77 %	120 %		
245-32	R7B-SPA	11/29/90	12/12/90	35 %	65 %	72 %	110 %		
245-33	R1B-SPA	12/13/90	12/14/90	46 %	65 %	63 %	95 %		
245-33, DUP	R1B-SPA, DUP	12/13/90	12/14/90	76 %	87 %	78 %	120 %		
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/12/90	46 %	51 %	50 %	73 %		
245-37	R9C-SCI	11/29/90	12/13/90	28 %	65 %	77 %	125 %		
BLANK 3	BLANK 3	11/30/90	12/13/90	31 %	44 %	63 %	110 %		
245-38,39	R9D-SCI-1,2	11/30/90	12/13/90	60 %	79 %	75 %	120 %		
245-38,39 DUP	R9D-SCI-1,2	11/30/90	12/13/90	59 %	78 %	76 %	120 %		
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/13/90	45 %	60 %	59 %	87 %		
245-43	R7C-SAL-1	11/30/90	12/13/90	56 %	81 %	78 %	120 %		
245-44	R7-SAL-2	11/30/90	12/13/90	73 %	86 %	83 %	130 %		
245-45	R5C-SAL-1	11/30/90	12/13/90	69 %	85 %	82 %	120 %		
245-46	R5C-SAL-2	11/30/90	12/13/90	23 %	70 %	84 %	130 %		
245-47	R4D-SAL-1	11/30/90	12/13/90	66 %	80 %	78 %	120 %		
245-48	R4D-SAL-2	11/30/90	12/13/90	67 %	85 %	81 %	120 %		
245-49	R7D-SAL-1	11/30/90	12/13/90	62 %	87 %	86 %	140 %		
245-50	R7D-SAL-2	11/30/90	12/13/90	62 %	85 %	82 %	130 %		

U indicates analyte not detected at detection limit shown
B indicates analyte present in blank associated with that sa
NA indicates not applicable

PAH MATRIX SPIKE PERCENT RECOVERIES cl# 245

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	% Moist.	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo[a] Anthra-cene	Benzo[b] Fluor-anthene	Benzo[k] Fluor-anthene	Benzo[a] pyrene	Benzo-(g,h,i)-perylene
Matrix spike	RSA-SPA-1,2,3	11/28/90	12/11/90	NA	105 %	107 %	114 %	119 %	111 %	103 %	104 %	109 %
Matrix Spike Dup	RSA-SPA-1,2,3	11/28/90	12/11/90	NA	114 %	114 %	128 %	129 %	117 %	114 %	114 %	119 %
Matrix spike	R9B-SCI-1,2,3	11/29/90	12/12/90	NA	106 %	97 %	111 %	117 %	107 %	101 %	100 %	91 %
Matrix Spike Dup	R9B-SCI-1,2,3	11/29/90	12/12/90	NA	103 %	103 %	114 %	120 %	108 %	102 %	98 %	88 %
Matrix spike	R9A-SCI, 1,2,3	11/30/90	12/13/90	NA	96 %	99 %	107 %	95 %	93 %	92 %	94 %	110 %
Matrix Spike Dup	R9A-SCI, 1,2,3	11/30/90	12/13/90	NA	91 %	91 %	101 %	100 %	91 %	89 %	87 %	92 %

PAH MATRIX SPIKE PERCENT RECOVERIES

PAH MATRIX SPIKE PERCENT RECOVERIES

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	Chrysene	Dibenzo-(a,h)-anthracene	Fluor-anthene	Fluorene	Indeno-1,2,3-Pyrene	2-Methyl-Naphthene	Naph-thalene	Phenan-threne	Pyrene
Matrix spike	RSA-SPA-1,2,3	11/28/90	12/11/90	99 %	105 %	113 %	111 %	110 %	NA	29 %	128 %	109 %
Matrix Spike Dup	RSA-SPA-1,2,3	11/28/90	12/11/90	108 %	129 %	129 %	134 %	123 %	NA	114 %	144 %	124 %
Matrix spike	R9B-SCI-1,2,3	11/29/90	12/12/90	103 %	118 %	143 %	128 %	101 %	NA	45 %	128 %	139 %
Matrix Spike Dup	R9B-SCI-1,2,3	11/29/90	12/12/90	104 %	112 %	123 %	124 %	102 %	NA	65 %	128 %	116 %
Matrix spike	R9A-SCI, 1,2,3	11/30/90	12/13/90	84 %	99 %	104 %	105 %	110 %	NA	84 %	102 %	101 %
Matrix Spike Dup	R9A-SCI, 1,2,3	11/30/90	12/13/90	86 %	75 %	94 %	101 %	94 %	NA	82 %	94 %	92 %

PAH MATRIX SPIKE PERCENT RECOVERIES

SURROGATE PERCENT RECOVERIES

Battelle Code	Sponsor Code	Date Ext'd	Date Anal'd	Naph- d8	Acen- d10	Phenan- d10?Q	B[a]P- d12
Matrix spike	RSA-SPA-1,2,3	11/28/90	12/11/90	57 %	64 %	59 %	89 %
Matrix Spike Dup	RSA-SPA-1,2,3	11/28/90	12/11/90	23 %	49 %	50 %	78 %
Matrix spike	R9B-SCI-1,2,3	11/29/90	12/12/90	13 %	35 %	53 %	100 %
Matrix Spike Dup	R9B-SCI-1,2,3	11/29/90	12/12/90	36 %	63 %	73 %	110 %
Matrix spike	R9A-SCI, 1,2,3	11/30/90	12/13/90	54 %	79 %	77 %	140 %
Matrix Spike Dup	R9A-SCI, 1,2,3	11/30/90	12/13/90	59 %	81 %	78 %	110 %

PLANT BUTYLTIN RESULTS

(Concentrations in ug/kg Dry Weight, ppm)

Battelle Code	Sponsor Code	Date Extracted	TETRABUTYL TIN	TRIBUTYL TIN	DIBUTYL TIN	MONOBUTYL TIN	SURROGATE RECOVERY TRIPENYLTIN
245-1	R5B-SPA	12/21/90	4.1 U	4.5 U	3.8 U	3.8 U	76%
245-2	R4B-SPA	12/21/90	4.2 U	4.6 U	3.9 U	3.9 U	78%
245-3	R7A-SPA	12/21/90	4.1 U	4.4 U	3.8 U	3.8 U	74%
245-4,5,6,	R2A-SPA-1,2,3	12/21/90	2.3 U	2.5 U	2.2 U	2.2 U	65%
245-7	R1A-SPA	1/15/91	4.7 U	9.2	4.3 U	19.8	89%
245-8,9	R2B-SPA-1,2	12/21/90	3.1 U	3.4 U	2.9 U	2.9 U	62%
245-10	RID-SAL-1	1/15/91	3.2 U	7.4	2.9 U	21.1	89%
245-11	RID-SAL-2	12/21/90	4.1 U	4.5 U	3.9 U	3.9 U	70%
245-12,14	RIC-SAL-1,3	12/21/90	1.6 U	1.8 U	1.5 U	1.5 U	65%
245-13,15	RIC-SAL-2,4	12/21/90	4.5 U	4.9 U	4.3 U	4.2 U	66%
245-16,18	R2D-SAL-1,3	1/15/91	3.2 U	7.4 B	2.9 U	12.5 B	89%
245-17,19	R2D-SAL-2,4	12/21/90	2.8 U	3.0 U	2.6 U	2.6 U	76%
245-20,21	R13C-TYP-1,2	12/21/90	3.2 U	3.6 U	3.0 U	3.0 U	46%
245-22,23	R13B-TYP-1,2	2/28/91	14.7 B	6.8 B	4.1 B	5.5 B	82%
245-24,25	R13D-TYP-1,2	2/28/91	18.3 B	4.3 B	2.3 B	3.3 B	82%
245-26	R13A-TYP	2/28/91	13.1 B	8.4 B	4.4 B	7.0 B	89%
245-27	R10D-TYP	2/28/91	6.3 B	2.2 B	3.7 B	14.0 B	92%
245-28	R10A-TYP	2/28/91	11.4 B	4.7 B	2.5 B	9.5 B	85%
245-29	R10C-TYP	2/28/91	11.0 B	3.9 B	2.8 B	2.2 U	83%
245-30,31	R10B-TYP-1,2	2/28/91	6.1 B	5.7 B	3.0 B	4.1 B	87%
245-32	R7B-SPA	12/21/90	3.3 U	3.6 U	3.1 U	3.1 U	51%
245-33	R1B SPA	12/21/90	3.3 U	3.7 U	3.1 U	3.1 U	56%
245-34,35,36 REP 1	R9B SCI-1,2,3 REP 1	1/15/91	3.2 U	6.5 B	2.9 U	2.9 U	92%
245-37	R9C-SCI	1/15/91	3.8 U	8.4 B	3.6	5.0	93%
245-38,39	R9D-SCI-1,2	1/15/91	5.1 U	14.7 B	6.7	4.6 U	84%
245-40,41,42 REP 1	R9A-SCI-1,2,3 REP 1	1/15/91	6.1	8.3 B	4.6	4.3	85%
245-43	R7C-SAL-1	1/15/91	8.2	9.6 B	5.6	6.1	89%
245-44	R7-SAL-2	1/15/91	7.4 U	18.0 B	131.8	25.1	89%
245-45	R5C-SAL-1	1/15/91	2.9 U	6.0 B	2.7 U	18.1	85%
245-46	R5C-SAL-2	1/15/91	6.9 U	16.5 B	12.9	6.3 U	89%
245-47	R4D-SAL-1	1/15/91	3.2 U	7.0 B	2.9 U	17.6	89%
245-48	R4D-SAL-2	1/15/91	7.4 U	18.1 B	11.8	17.7	92%
245-49	R7D-SAL-1	1/15/91	5.8 U	12.6 B	13.2	5.3 U	91%
245-50	R7D-SAL-2	1/15/91	6.0 U	13.3 B	16.6	5.4 U	89%
PROCEDURAL BLANK		12/21/90	5.8 U	6.4 U	6.4 U	5.3 U	38%
PROCEDURAL BLANK		1/15/91	4.2 U	7.9	3.8 U	3.8 U	85%
PROCEDURAL BLANK		2/28/91	4.7	6.5	2.6	5.9	75%

B indicates analyte detected in blank. Note, blanks for specific samples are identified by corresponding "extraction date".

U indicates analyte not detected at detection limit shown

MATRIX SPIKE RECOVERIES

(Concentrations In ug/kg Dry Weight, ppm)

	Sponsor Code		TETRABUTYL TIN	TRIBUTYL TIN	DIBUTYL TIN	MONOBUTYL TIN	SURROGATE RECOVERY TRIPENYLTIN
Sample Concentration:	R9B-SCI-1,2,3 REP 1	12/21/90	3.2 U	6.5	2.9 U	2.9 U	92%
Amount Spiked:			893.0	893.0	893.0	893.0	
Amount Recovered:			600.1	701.1	692.2	194.1	87%
Percent Recovery :			67%	78%	77%	22%	
Sample Concentration:	R1A-SPA	1/15/91	4.7 U	9.2	4.3 U	19.8	89%
Amount Spiked:			1087.0	1087.0	1087.0	1087.0	
Amount Recovered:			824.5	885.4	852.3	178.6	87%
Percent Recovery :			75%	81%	78%	15%	

PLANT PCB RESULTS
(Concentrations in ug/Kg Dry Weight, ppb)

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	% Moist.	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	SURROGATE DBC
BLANK 1	BLANK 1	11/28/90	12/3/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	92 %
245-1	R5B-SPA	11/28/90	12/3/90	86	100 U	100 U	100 U	100 U	100 U	100 U	100 U	102 %
245-2	R4B-SPA	11/28/90	12/3/90	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	68 %
245-3	R7A-SPA	11/28/90	12/3/90	81	100 U	100 U	100 U	100 U	100 U	100 U	100 U	65 %
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	80	100 U	100 U	100 U	100 U	100 U	100 U	100 U	56 %
245-7	R1A-SPA	11/28/90	12/3/90	82	100 U	100 U	100 U	100 U	100 U	100 U	100 U	61 %
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	82 %
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	72 %
245-10	RID-SAL-1	11/28/90	12/4/90	73	100 U	100 U	100 U	100 U	100 U	100 U	100 U	79 %
245-11	RID-SAL-2	11/28/90	12/4/90	91	100 U	100 U	100 U	100 U	100 U	100 U	100 U	153 %
245-12,14	RIC-SAL-1,3	11/28/90	12/4/90	72	100 U	100 U	100 U	100 U	100 U	100 U	100 U	82 %
245-13,15	RIC-SAL-2,4	11/28/90	12/4/90	89	100 U	100 U	100 U	100 U	100 U	100 U	100 U	86 %
245-16,18	R2D-SAL-1,3	11/28/90	12/4/90	73	100 U	100 U	100 U	100 U	100 U	100 U	100 U	90 %
245-17,19	R2D-SAL-2,4	11/28/90	12/4/90	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	144 %
BLANK 2	BLANK 2	11/29/90	12/4/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	78 %
245-20,21	R13C-TYP-1,2	11/29/90	12/4/90	86	100 U	100 U	100 U	100 U	100 U	100 U	100 U	68 %
245-22,23	R13B-TYP-1,2	11/29/90	12/4/90	88	100 U	100 U	100 U	100 U	100 U	100 U	100 U	99 %
245-24,25	R13D-TYP-1,2	11/29/90	12/4/90	81	100 U	100 U	100 U	100 U	100 U	100 U	100 U	46 %
245-26	R13A-TYP	11/29/90	12/4/90	90	100 U	100 U	100 U	100 U	100 U	100 U	100 U	67 %
245-17	R10D-TYP	11/29/90	12/4/90	88	100 U	100 U	100 U	100 U	100 U	100 U	100 U	99 %
245-28	R10A-TYP	11/29/90	12/4/90	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	51 %
245-29	R10C-TYP	11/29/90	12/4/90	81	100 U	100 U	100 U	100 U	100 U	100 U	100 U	75 %
245-30,31	R10B-TYP-1,2	11/29/90	12/4/90	82	100 U	100 U	100 U	100 U	100 U	100 U	100 U	67 %
245-32	R7B-SPA	11/29/90	12/4/90	80	100 U	100 U	100 U	100 U	100 U	100 U	100 U	82 %
245-33	R1B-SPA	11/29/90	12/5/90	86	100 U	100 U	100 U	100 U	100 U	100 U	100 U	65 %
245-33	R1B-SPA	11/29/90	12/5/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	77 %
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	77	100 U	100 U	100 U	100 U	100 U	100 U	100 U	39 %
245-37	R9C-SCI	11/29/90	12/5/90	80	100 U	100 U	100 U	100 U	100 U	100 U	100 U	40 %
BLANK 3	BLANK 3	11/30/90	12/5/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	63 %
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	82	100 U	100 U	100 U	100 U	100 U	100 U	100 U	66 %
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	NA	100 U	100 U	100 U	100 U	100 U	100 U	100 U	78 %
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	75	100 U	100 U	100 U	100 U	100 U	100 U	100 U	66 %
245-43	R7C-SAL-1	11/30/90	12/5/90	78	100 U	100 U	100 U	100 U	100 U	100 U	100 U	85 %
245-44	R7-SAL-2	11/30/90	12/5/90	93	100 U	100 U	100 U	100 U	100 U	100 U	100 U	83 %
245-45	R5C-SAL-2	11/30/90	12/5/90	74	100 U	100 U	100 U	100 U	100 U	100 U	100 U	83 %
245-46	R5C-SAL-1	11/30/90	12/5/90	89	100 U	100 U	100 U	100 U	100 U	100 U	100 U	95 %
245-47	R4D-SAL-1	11/30/90	12/5/90	76	100 U	100 U	100 U	100 U	100 U	100 U	100 U	77 %
245-48	R4D-SAL-2	11/30/90	12/5/90	88	100 U	100 U	100 U	100 U	100 U	100 U	100 U	82 %
245-49	R7D-SAL-1	11/30/90	12/6/90	80	100 U	100 U	100 U	100 U	100 U	100 U	100 U	70 %
245-50	R7D-SAL-2	11/30/90	12/6/90	89	100 U	100 U	100 U	100 U	100 U	100 U	100 U	86 %

U indicates analyte not detected above detection limit shown.
NA indicates not applicable

PESTICIDE RESULTS
(Concentrations in ug/Kg Dry Weight, ppb)

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	% Moist.	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	Chlordane	4,4'-DDD
BLANK 1	BLANK 1	11/28/90	12/3/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-1	R5B-SPA	11/28/90	12/3/90	86	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-2	R4B-SPA	11/28/90	12/3/90	85	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-3	R7A-SPA	11/28/90	12/3/90	81	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	80	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-7	R1A-SPA	11/28/90	12/3/90	82	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	85	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-10	RID-SAL-1	11/28/90	12/4/90	73	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-11	RID-SAL-2	11/28/90	12/4/90	91	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-12,14	RIC-SAL-1,3	11/28/90	12/4/90	72	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-13,15	RIC-SAL-2,4	11/28/90	12/4/90	89	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-16,18	R2D-SAL-1,3	11/28/90	12/4/90	73	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-17,19	R2D-SAL-2,4	11/28/90	12/4/90	85	20 U	20 U	20 U	20 U	20 U	30 U	20 U
BLANK 2	BLANK 2	11/29/90	12/4/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-20,21	R13C-TYP-1,2	11/29/90	12/4/90	86	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-22,23	R13B-TYP-1,2	11/29/90	12/4/90	88	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-24,25	R13D-TYP-1,2	11/29/90	12/4/90	81	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-26	R13A-TYP	11/29/90	12/4/90	90	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-17	R10D-TYP	11/29/90	12/4/90	88	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-28	R10A-TYP	11/29/90	12/4/90	85	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-29	R10C-TYP	11/29/90	12/4/90	81	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-30,31	R10B-TYP-1,2	11/29/90	12/4/90	82	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-32	R7B-SPA	11/29/90	12/4/90	80	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-33	R1B-SPA	11/29/90	12/5/90	86	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-33	R1B-SPA	11/29/90	12/5/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	77	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-37	R9C-SCI	11/29/90	12/5/90	80	20 U	20 U	20 U	20 U	20 U	30 U	20 U
BLANK 3	BLANK 3	11/30/90	12/5/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	82	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	NA	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	75	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-43	R7C-SAL-1	11/30/90	12/5/90	78	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-44	R7-SAL-2	11/30/90	12/5/90	93	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-45	R5C-SAL-2	11/30/90	12/5/90	74	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-46	R5C-SAL-1	11/30/90	12/5/90	89	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-47	R4D-SAL-1	11/30/90	12/5/90	76	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-48	R4D-SAL-2	11/30/90	12/5/90	88	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-49	R7D-SAL-1	11/30/90	12/6/90	80	20 U	20 U	20 U	20 U	20 U	30 U	20 U
245-50	R7D-SAL-2	11/30/90	12/6/90	89	20 U	20 U	20 U	20 U	20 U	30 U	20 U

U indicates analyte not detected above detection limit shown.
NA indicates not applicable

PESTICIDE RESULTS

(Concentrations in ug/Kg Dry Weight, ppb)

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	4,4'-DDE	4,4'-DDT	Dieldrin	Endo-sulfan I	Endo-sulfan II	Sulfate	Endrin
BLANK 1	BLANK 1	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-1	R5B-SPA	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	670
245-2	R4B-SPA	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-3	R7A-SPA	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-7	R1A-SPA	11/28/90	12/3/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-10	RID-SAL-1	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-11	RID-SAL-2	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-12,14	RIC-SAL-1,3	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-13,15	RIC-SAL-2,4	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-16,18	R2D-SAL-1,3	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-17,19	R2D-SAL-2,4	11/28/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
BLANK 2	BLANK 2	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-20,21	R13C-TYP-1,2'	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-22,23	R13B-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	27	20 U
245-24,25	R13D-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-26	R13A-TYP	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-17	R10D-TYP	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-28	R10A-TYP	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-29	R10C-TYP	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-30 31	R10B-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-32	R7B-SPA	11/29/90	12/4/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-33	R1B-SPA	11/29/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-33	R1B-SPA	11/29/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-37	R9C-SCI	11/29/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
BLANK 3	BLANK 3	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-43	R7C-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-44	R7-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-45	R5C-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-46	R5C-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-47	R4D-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-48	R4D-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-49	R7D-SAL-1	11/30/90	12/6/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U
245-50	R7D-SAL-2	11/30/90	12/6/90	20 U	20 U	20 U	20 U	20 U	20 U	20 U

U indicates analyte not detected above detection limit show
NA indicates not applicable

PESTICIDE RESULTS

(Concentrations in ug/Kg Dry Weight, ppb)

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	Endrin Aldehyde	Heptachlor	Heptachlor Epoxide	Methoxy-chlor	Toxaphene	SURROGATE DBC
BLANK 1	BLANK 1	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	92 %
245-1	R5B-SPA	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	102 %
245-2	R4B-SPA	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	68 %
245-3	R7A-SPA	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	65 %
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	56 %
245-7	R1A-SPA	11/28/90	12/3/90	20 U	20 U	20 U	30 U	200 U	61 %
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	82 %
245-8,9	R2B-SPA-1,2	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	72 %
245-10	RID-SAL-1	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	79 %
245-11	RID-SAL-2	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	153 %
245-12,14	RIC-SAL-1,3	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	82 %
245-13,15	RIC-SAL-2,4	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	86 %
245-16,18	R2D-SAL-1,3	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	90 %
245-17,19	R2D-SAL-2,4	11/28/90	12/4/90	20 U	20 U	20 U	30 U	200 U	144 %
BLANK 2	BLANK 2	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	78 %
245-20,21	R13C-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	68 %
245-22,23	R13B-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	99 %
245-24,25	R13D-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	46 %
245-26	R13A-TYP	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	67 %
245-17	R10D-TYP	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	99 %
245-28	R10A-TYP	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	51 %
245-29	R10C-TYP	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	75 %
245-30,31	R10B-TYP-1,2	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	67 %
245-32	R7B-SPA	11/29/90	12/4/90	20 U	20 U	20 U	30 U	200 U	82 %
245-33	R1B SPA	11/29/90	12/5/90	20 U	20 U	20 U	30 U	200 U	65 %
245-33	R1B-SPA	11/29/90	12/5/90	20 U	20 U	20 U	30 U	200 U	77 %
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	20 U	20 U	20 U	30 U	200 U	39 %
245-37	R9C-SCI	11/29/90	12/5/90	20 U	20 U	20 U	30 U	200 U	40 %
BLANK 3	BLANK 3	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	63 %
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	66 %
245-38,39	R9D-SCI-1,2	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	78 %
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	66 %
245-43	R7C-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	85 %
245-44	R7-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	83 %
245-45	R5C-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	83 %
245-46	R5C-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	95 %
245-47	R4D-SAL-1	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	77 %
245-48	R4D-SAL-2	11/30/90	12/5/90	20 U	20 U	20 U	30 U	200 U	82 %
245-49	R7D-SAL-1	11/30/90	12/6/90	20 U	20 U	20 U	30 U	200 U	70 %
245-50	R7D-SAL-2	11/30/90	12/6/90	20 U	20 U	20 U	30 U	200 U	86 %

U indicates analyte not detected above detection limit show
NA indicates not applicable

PESTICIDE MATRIX SPIKE RECOVERIES

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	% Moist.	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	Chlordane	4,4'-DDD
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	71 %	NA	NA	NA	NA	NA	NA
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	88 %	NA	NA	NA	NA	NA	NA
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	79 %	NA	NA	NA	NA	NA	NA
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	102 %	NA	NA	NA	NA	NA	NA
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	105 %	NA	NA	NA	NA	NA	NA
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	99 %	NA	NA	NA	NA	NA	NA

PESTICIDE MATRIX SPIKE RECOVERIES

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	4,4'-DDE	4,4'-DDT	Dieldrin	Endo-sulfan I	Endo-sulfan II	Sulfate	Endrin
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	NA	48 %	NA	NA	NA	NA
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	NA	58 %	NA	NA	NA	NA
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	NA	47 %	NA	NA	NA	NA
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	NA	64 %	NA	NA	NA	NA
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	NA	84 %	NA	NA	NA	NA
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	NA	62 %	NA	NA	NA	NA

PESTICIDE MATRIX SPIKE RECOVERIES

Client Sample ID	Sponsor Code	Date Ext'd	Date Anal'd	Endrin Aldehyde	Heptachlor	Heptachlor Epoxide	Methoxy-chlor	Toxaphene	DBC
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	NA	NA	NA	200 NA	NA
245-4,5,6	R2A-SPA-1,2,3	11/28/90	12/3/90	NA	NA	NA	NA	200 NA	67 %
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	NA	NA	NA	200 NA	46 %
245-34,35,36	R9B-SCI-1,2,3	11/29/90	12/5/90	NA	NA	NA	NA	200 NA	70 %
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	NA	NA	NA	200 NA	66 %
245-40,41,42	R9A-SCI-1,2,3	11/30/90	12/5/90	NA	NA	NA	NA	200 NA	65 %

277TBT.WK1

BUTYLTINS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(Concentrations in ug/kg dry weight)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Pentylbutyl % Internal	Tetra	Tributyl	Dibutyl	Monobutyl
277- 1-R	SED09-CB	75.47	123.0	1.9 U	3.2	3.3	5.8
277- 2	SED07-CM	98.55	131.6	2.9	2.0	9.6	2.1
277- 3-R	SED01-MR	74.94	133.6	1.3 U	2.3	1.4 U	1.3 U
277-. 4-R	SED05-CM	73.13	137.3	1.2 U	3.1	1.7	1.2 U
277- 5-R	SED10-CB	75.68	134.1	1.5 U	3.6	1.6 U	4.7
277- 6-R	SED13-CF	67.43	142.8	0.9 U	1.8	0.9 U	0.9 U
277- 7-R	SED08-CM	75.64	122.7	2.0	2.3	1.4 U	1.3 U
277- 8-R	SED14-BR	73.00	140.4	1.3 U	3.5	1.8	2.4
277- 9-R	SED11-CB	75.35	142.5	0.9 U	33.4	0.9 U	0.9 U
277- 10-R	SED04-CM	86.65	127.5	1.4 U	3.1	2.0	2.3
277- 11	SED02-CM	148.81	142.4	0.5	2.6	3.6	17.0
277- 12-R	SED03-CM	83.58	133.6	3.0	2.6	1.4 U	2.9
277- 13-R	SEDWR09-CM	83.68	135.9	0.8 U	1.3	0.8 U	0.7 U
277- 14	08A-SAL	128.66	145.5	2.4	4.5	2.2	53.5
277- 15	14C-SAL	100.94	155.1	2.4	4.8	2.2	35.1
277- 16	08C-SAL	98.79	134.9	2.0	3.5	11.1	24.6
277- 17	04C-SAL	119.99	140.7	3.2	6.0	19.0	64.3
277- 18	03C-SAL	91.91	126.7	2.2	3.1	6.6	15.6
277- BLK-2		83.66	136.6	3.3	4.8	12.1	24.7
277- 19R	11C-SCI	80.40	144.4	2.2 U	4.1	2.1 U	4.4
277- 20-R	11A-SCI	76.59	118.9	4.1 U	5.6	5.6	3.7 U
277- 21	11B-SCI	129.64	136.8	5.5	5.2	2.6	9.5
277- 22-R	03B-SPA	96.66	111.0	3.6 U	8.3	3.7	5.1
277- 23	04A-SPA	152.9	64.4	2.7	5.2	2.5	NA
277- 24	14A-SCI	178.00	44.0	1.2	2.2	1.1	NA
277- 25-R	14D-SAL	81.97	117.4	3.1 U	4.4	3.0 U	5.6
277- 26-R	02C-SAL	88.17	113.4	9.7	6.5	3.5 U	7.1
277- 27	05D-SAL	74.01	127.2	54.7	35.8	2.3	5.3
277- 28	03D-SAL	74.05	126.2	3.3	4.8	4.4	7.1
227- BLK-4		67.67	133.7	2.2 U	3.9	2.1 U	10.2
277- 29	08D-SAL	61.68	122.9	2.3 U	4.0	2.8	2.1
277- 30	08B-SAL	63.86	136.4	3.1 U	5.3	3.1 U	2.9 U
277- 31-R	08B-SAL	90.86	115.6	3.6 U	5.6	3.6 U	6.4
277 BLANK		75.31	123.8	3.8 U	5.3	3.7 U	8.7
277- 32	03A-SPA	62.55	121.0	2.1 U	2.9	2.1 U	1.9 U
277- 33	05A-SPA	70.21	125.6	2.2 U	5.2	2.2 U	2.0 U
277- 34	R08-SN01	85.92	112.1	1.6 U	3.3	5.0	1.5 U

BUTYLTINS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(Concentrations in ug/kg dry weight)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Pentylbutyl % Internal	Tetra	Tributyl	Dibutyl	Monobutyl
277- 34 DUP	R08-SN01	80.00	128.8	1.4 U	3.5	4.2	1.7
277- 35	R08-SN02	80.15	134.2	0.6 U	1.4	0.9	1.6
277- 36	R13-CBR1	71.18	132.5	14.6	40.7	30.1	11.8
277- 37	R01-MOR1	69.60	122.2	3.9 U	34.9	9.3	7.8
277- 38	RO1-MOR2	131.20	52.3	5.0 U	38.3	5.0 U	4.6 U

U indicates not detected at detection limit shown

MATRIX SPIKE RESULTS

277-1-C SPIKE		69.36	144.4	168.0	219.6	243.0	37.6
Percent Recovery				35%	46%	51%	7.7%
277-5-C SPIKE		67.29	142.5	149.6	184.6	31.5	123.4
Percent Recovery				34%	41%	7%	28%
277-8-C SPIKE		82.71	125.4	138.4	203.7	260.7	44.8
Percent Recovery				35%	51%	66%	11%
227-BLANK SPIKE		76.42	177.2	294.4	301.6	327.5	221.5
Percent Recovery				58%	59%	65%	43%
277-36 SPIKE		73.86	128.1	1004.6	1153.7	841.8	63.5
Percent Recovery				60%	69%	50%	4%

METALS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(concentrations in mg/kg dry weight)

MSL Code	Rep	Sponsor ID	Rep	Ag AA	As XRF	Cd AA	(a) Cr AA/XRF	Cu XRF	Hg CVAA	Ni XRF	(a) Pb AA/XRF	(b) Se AA/XRF	Zn XRF
SEDIMENT													
277- 1	REP 1	SED09-CB	REP 1	0.448	19.3	0.28	183.0	68.5	0.383	107.7	85.6	0.41	142.2
277- 1	REP 2	SED09-CB	REP 2	0.446	20.7	0.28	168.0	72.4	0.394	106.6	84.6	0.39	145.5
277- 2		SED07-CM		0.355	10.6	0.33	195.0	67.5	0.469	119.8	33.8	0.33	157.5
277- 3		SED01-MR		1.418	23.7	0.33	174.0	71.6	0.515	102.0	36.3	0.33	137.2
277- 4		SED05-CM		0.660	14.4	0.26	179.0	67.6	0.419	125.9	34.1	0.25	158.4
277- 5		SED10-CB		0.359	17.2	0.56	126.0	67.9	0.321	93.3	47.8	0.91	135.0
277- 6		SED13-CF		0.234	5.36	0.55	110.0	24.2	0.059	32.2	14.0	0.14 U	161.7
277- 7		SED08-CM		0.023	5.29	0.41	224.0	35.9	0.074	72.2	20.9	0.14 U	88.5
277- 8		SED14-BR		0.206	16.9	0.36	193.0	77.3	0.362	122.1	32.5	0.25	164.7
277- 9		SED11-CB		0.350	15.3	0.22	181.0	50.3	0.283	83.3	13.7	0.16	89.8
277-10		SED04-CM		0.143	13.4	0.31	214.0	72.6	0.439	135.5	35.7	0.17	160.1
277-11		SED02-CM		0.372	18.5	0.32	219.0	90.6	0.469	125.4	36.8	0.33	158.9
277-12		SED03-CM		0.479	18.2	0.41	179.0	70.1	0.166	145.2	33.0	0.42	166.1
277-13		SEDWR09-CM		0.194	9.9	0.22	256.0	28.6	0.164	72.7	13.2	0.17	77.8
PLANTS													
277-14	REP 1	08A-SAL		0.003 U	1.3 U	0.13	0.4	9.7	0.024	1.7 U	0.23	1.10 U	27.3
277-14	REP 2	14C-SAL		0.003 U	0.96 U	0.13	0.4	9.2	0.023	2.33	0.34	1.10 U	29.2
277-15	REP 1	14C-SAL		0.003	0.92 U	0.17	3.6	10.1	0.034	3.78	0.99	0.70 U	30.8
277-15	REP 2	14C-SAL		-	-	-	3.9 *	-	-	-	1.27 *	-	-
277-16		08C-SAL		0.007	0.85 U	0.21	0.4	8.7	0.030	1.48	0.92	0.66 U	36.0
277-17		04C-SAL		0.007	1.0 U	0.29	5.9	19.1	0.038	6.29	1.42	0.79 U	45.7
277-18		03C-SAL		0.003 U	1.0	0.05	1.8	8.0	0.016	3.31	0.66	0.65 U	26.6
277-19		11C-SCI		0.003 U	0.79 U	0.16	0.7	15.3	0.018	4.47	0.49	0.56 U	88.7
277-20		11A-SCI		0.003 U	0.87	0.17	2.7	31.1	0.050	6.70	0.87	0.62 U	89.9
277-21		11B-SCI		0.003 U	0.89 U	0.24	4.0	17.4	0.044	9.39	1.03	0.65 U	133.0
277-22		03B-SPA		0.135	1.04	0.12	7.7	13.9	0.025	9.29	1.84	0.64 U	84.9
277-23		04A-SPA		0.107	1.82	0.07	2.5	8.9	0.014	2.05	0.60	0.68 U	60.9
277-24		14A-SCI		0.034	0.79 U	0.08	3.3	7.7	0.038	3.47	1.18	0.58 U	48.4
277-25		14D-SAL		0.009	0.95 U	0.07	1.7	11.4	0.019	1.85	0.71	0.71 U	29.8
277-26		02C-SAL		0.003	0.91 U	0.16	1.8	10.8	0.019	2.47	0.61	2.20 U	40.0
277-27		05D-SAL		0.014	0.88 U	0.06	4.1	11.5	0.018	4.49	0.86	0.66 U	44.3
277-28		03D-SAL		0.009	0.86 U	0.08	2.6	12.0	0.021	5.27	0.93	0.64 U	25.8
277-29		08D-SAL		0.003	0.83 U	0.15	0.4	8.9	0.025	0.93 U	0.38	0.65 U	36.3
277-30		08B-SAL		0.003	0.99 U	0.10	0.5	8.8	0.018	1.47	0.49	0.77 U	57.4
277-31		11D-SCI		0.005	0.84 U	0.13	1.9	13.6	0.028	5.81	0.76	0.61 U	59.3
277-32		03A-SPA		0.217	1.27	0.06	7.2	13.7	0.022	8.76	1.39	0.63 U	98.0
277-33		05A-SPA		0.165	0.99	0.08	8.5	11.4	0.027	9.1	2.04	0.65 U	65.5

METALS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(concentrations in mg/kg dry weight)

MSL Code	Rep	Sponsor ID	Rep	Ag AA	As XRF	Cd AA	(a) Cr AA/XRF	Cu XRF	Hg CVAA	Ni XRF	(a) Pb AA/XRF	(b) Se AA/XRF	Zn XRF
TISSUES													
277-34		R08-SN01		0.347	11.62	1.03	2.2	93.6	0.180	10.2	1.15	1.33	401.0
277-34		R08-SN01		0.360	9.22	1.03	2.1	74.3	0.172	8.5	1.43	1.04	309.0
277-35		R08-SN02		0.121	2.5	0.34	1.2	23.5	0.055	4.5	0.82	1.47	131.4
277-36		R13-CBR1		1.03	10.79	3.34	4.3	164.1	0.469	5.78	1.89	3.98	273.0
277-37		R01-MOR1		0.819	8.76	3.53	4.0	23.1	0.398	7.74	1.71	4.19	71.7
277-38		R01-MOR2		0.914	8.93	3.45	3.3	20.5	0.304	5.33	1.39	3.52	71.1
Blank				0.019	N/A	0.01 U	0.8	N/A	0.001 U	N/A	N/A	0.14 U	N/A
Blank				0.007	N/A	0.01 U	0.8	N/A	0.001 U	N/A	0.17 U	0.14 U	N/A

U indicates not detected at detection limit shown

N/A indicates not applicable

PESTICIDES IN SED., PLANT & TISSUE ι TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT) 3HT)

	% Moist.	% Moist.	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	Chlor-dane	4,4-DDD	4,4-DDDE	4,4-DDDT	Dieldrin
SEDIMENT												
SEDIMENT METHOD BLANK	N/A	N/A	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 1 SED09-CB	60	60	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.6	3.0 U	3.0 U
277- 2 SED07-CM	55	55	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 3 SED01-MR	47	47	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 4 SED05-CM	45	45	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 5 SED10-CB	72	72	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
277- 6 SED13-CF	33	33	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 7 SED08 CM	38	38	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 8 SED14-BR	34	34	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 9 SED11-CB	32	32	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 10 SED04-CM	54	54	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 11 SED02-CM	49	49	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 12 SED03 CM	57	57	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
277- 13 SEDWR09-CM	19	19	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
PLANTS												
PLANT METHOD BLANK	N/A	N/A	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 14 08A-SAL	89	89	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 15 14C-SAL	89	89	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 16 08C-SAL	86	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 17 04C-SAL	90	90	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.0 U
277- 18 03C-SAL	84	84	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 19 11C-SCI	90	90	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 20 11A-SCI	87	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 21 11B SCI	86	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 22 03B SPA	87	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 23 04A-SPA	87	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 24 14A-SCI	74	74	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 25 14D-SAL	81	81	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 26 02C-SAL	84	84	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 27 05D-SAL	87	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 28 03D-SAL	85	85	2.0 U	2.3	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 29 08D-SAL	87	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 30 08B-SAL	86	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 31 11D-SCI	88	88	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.0 U
277- 32 03A-SPA	86	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
277- 33 05A-SPA	84	84	2.0 U	3.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

PESTICIDES IN SED., PLANT & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

	% Moist.	Endo-sulfan I	Endo-sulfan I	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Hepta-chlor	Heptachlor Epoxide	Methoxy-chlor	Toxa-phene	PERCENT RECOVERY SURROGATE DBC
SEDIMENT											
SEDIMENT METHOD BLANK	N/A	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	37
277- 1 SED09-CB	60	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	57
277- 2 SED07-CM	55	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	63
277- 3 SED01-MR	47	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	73
277- 4 SED05 CM	45	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	9
277- 5 SED10-CB	72	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	250 U	32
277- 6 SED13-CF	33	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	38
277- 7 SED08-CM	38	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	59
277- 8 SED14-BR	34	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	87
277- 9 SED11-CB	32	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	97
277- 10 SED04-CM	54	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	121
277- 11 SED02-CM	49	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	83
277- 12 SED03 CM	57	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	87
277- 13 SEDWR09-CM	19	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	200 U	92
PLANTS											
PLANT METHOD BLANK	N/A	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	63
277- 14 08A-SAL	89	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	71
277- 15 14C SAL	89	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	132
277- 16 08C-SAL	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	89
277- 17 04C-SAL	90	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	122
277- 18 03C-SAL	84	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	11
277- 19 11C-SCI	90	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	67
277- 20 11A-SCI	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	106
277- 21 11B-SCI	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	113
277- 22 03B SPA	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	121
277- 23 04A-SPA	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	48
277- 24 14A-SCI	74	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	32
277- 25 14D-SAL	81	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	103
277- 26 02C-SAL	84	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	87
277- 27 05D-SAL	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	122
277- 28 03D-SAL	85	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	176
277- 29 08D-SAL	87	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	138
277- 30 08B SAL	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	154
277- 31 11D-SCI	88	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	79
277- 32 03A-SPA	86	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	87
277- 33 05A-SPA	84	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	100 U	75

PESTICIDES IN SED., PLANT & TISSUE & TISSUE
Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT) 3HT)

	% Moist.	% Moist.	Aldrin	Alpha-BHC	Beta-BHC	Delta-BHC	Gamma-BHC	Chlor-dane	4,4-DDD	4,4-DDDE	4,4-DDDT	Dieldrin
TISSUE												
TISSUE METHOD BLANK	N/A	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 34 R08-SN01	66	66	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 34 R08-SN01	66	66	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	17 U	10 U
277- 35 RO8-SN02	35	35	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 36 R13-CBR1	92	92	10 U	10 U	12 U	24 U	10 U	10 U	10 U	115 U	30 U	16
277- 37 R01-MOR1	85	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 38 R01-MOR2	88	88	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

U indicates not detected at detection limits shon limits shown

PESTICIDES IN SED., PLANT & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

	% Moist.	Endo-sulfan I	Endo-sulfan I	Endosulfan Sulfate	Endrin	Endrin Aldehyde	Hepta-chlor	Heptachlor Epoxide	Methoxy-chlor	Toxa-phene	PERCENT RECOVERY SURROGATE DBC
TISSUE											
TISSUE METHOD BLANK	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	67
277- 34 R08-SN01	66	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	111
277- 34 R08-SN01	66	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	157
277- 35 RO8-SN02	35	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	110
277- 36 R13-CBR1	92	10 U	10 U	10 U	18	10 U	42	10 U	10 U	500 U	119
277- 37 R01-MOR1	85	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	130
277- 38 R01-MOR2	88	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	500 U	70

U indicates not detected at detection limits sho

PCBs IN SED., PLANT & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

	% Moist.	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PERCENT RECOVERY SURROGATE DBC
SEDIMENT									
SEDIMENT METHOD BLANK	N/A	30 U	30 U	30 U	30 U	30 U	30 U	30 U	
277- 1 SED09-CB	60	30 U	30 U	30 U	30 U	30 U	30 U	30 U	37
277- 2 SED07-CM	55	30 U	30 U	30 U	30 U	30 U	30 U	30 U	57
277- 3 SED01-MR	47	30 U	30 U	30 U	30 U	30 U	30 U	30 U	63
277- 4 SED05-CM	45	30 U	30 U	30 U	30 U	30 U	150	30 U	73
277- 5 SED10-CB	72	30 U	30 U	30 U	30 U	30 U	30 U	30 U	9
277- 6 SED13-CF	33	50 U	50 U	50 U	50 U	50 U	50 U	50 U	32
277- 7 SED08-CM	38	30 U	30 U	30 U	30 U	30 U	30 U	30 U	38
277- 8 SED14-BR	34	30 U	30 U	30 U	30 U	30 U	30 U	30 U	59
277- 9 SED11-CB	32	30 U	30 U	30 U	30 U	30 U	30 U	30 U	87
277- 10 SED04-CM	54	30 U	30 U	30 U	30 U	30 U	30 U	30 U	97
277- 11 SED02-CM	49	30 U	30 U	30 U	30 U	30 U	120	30 U	121
277- 12 SED03-CM	57	30 U	30 U	30 U	30 U	30 U	83	30 U	83
277- 13 SEDWR09-CM	19	30 U	30 U	30 U	30 U	30 U	210	30 U	87
		30 U	30 U	30 U	30 U	30 U	75	30 U	92
PLANTS									
PLANT METHOD BLANK	N/A	20 U	20 U	20 U	20 U	20 U	20 U	20 U	
277- 14 08A-SAL	89	20 U	20 U	20 U	20 U	20 U	20 U	20 U	63
277- 15 14C-SAL	89	20 U	20 U	20 U	20 U	20 U	20 U	20 U	71
277- 16 08C-SAL	86	20 U	20 U	20 U	20 U	20 U	20 U	20 U	132
277- 17 04C-SAL	90	20 U	20 U	20 U	20 U	20 U	20 U	20 U	89
277- 18 03C-SAL	84	20 U	20 U	20 U	20 U	20 U	20 U	20 U	122
277- 19 11C-SCI	90	20 U	20 U	20 U	20 U	20 U	20 U	20 U	11
277- 20 11A-SCI	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	67
277- 21 11B-SCI	86	20 U	20 U	20 U	20 U	20 U	20 U	20 U	106
277- 22 03B-SPA	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	113
277- 23 04A-SPA	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	121
277- 24 14A-SCI	74	20 U	20 U	20 U	20 U	20 U	20 U	20 U	48
277- 25 14D-SAL	81	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32
277- 26 02C-SAL	84	20 U	20 U	20 U	20 U	20 U	20 U	20 U	103
277- 27 05D-SAL	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	87
277- 28 03D-SAL	85	20 U	20 U	20 U	20 U	20 U	20 U	20 U	122
277- 29 08D-SAL	87	20 U	20 U	20 U	20 U	20 U	20 U	20 U	176
277- 30 08B-SAL	86	20 U	20 U	20 U	20 U	20 U	20 U	20 U	138
277- 31 11D-SCI	88	20 U	20 U	20 U	20 U	20 U	20 U	20 U	154
277- 32 03A-SPA	86	20 U	20 U	20 U	20 U	20 U	20 U	20 U	79
277- 33 05A-SPA	84	20 U	20 U	20 U	20 U	20 U	20 U	20 U	87
		20 U	20 U	20 U	20 U	20 U	20 U	20 U	75

PCBs IN SED., PLANT & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

	% Moist.	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PERCENT RECOVERY SURROGATE DBC
TISSUE									
TISSUE METHOD BLANK	N/A	100 U	100 U	100 U	100 U	100 U	100 U	100 U	67
277- 34 R08 SN01	66	100 U	100 U	100 U	100 U	100 U	100 U	100 U	111
277- 34 R08 SN01	66	100 U	100 U	100 U	100 U	100 U	100 U	100 U	157
277- 35 R08 SN02	35	100 U	100 U	100 U	100 U	100 U	100 U	100 U	110
277- 36 R13 CBR1	92	100 U	100 U	100 U	100 U	100 U	100 U	100 U	119
277- 37 R01 MOR1	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	130
277- 38 R01 MOR2	88	100 U	100 U	100 U	100 U	100 U	100 U	100 U	70

U indicates not detected at detection limits sho

PCB and Pesticide Matrix Spike Recoveries

Battelle Code	Sponsor Codes	Aldrin	Dieldrin	Aroclor-1254	Surrogate DBC
277- 12	SED03-CM	61%	113%	79%	
277- 12	SED03-CM	62%	88%		ND
277- 33	05A-SPA	57%	59%	189%	165%
277- 33	05A-SPA	58%	50%	144%	129%
277- 36	R13-CBR1	107%	80%	83%	116%
277- 36	R13-CBR1	83%	83%	100%	103%

PCBs IN SED., PLANT & TISSUE
Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

	% Moist.	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	PERCENT RECOVERY SURROGATE DBC
TISSUE									
TISSUE METHOD BLANK	N/A	100 U	100 U	100 U	100 U	100 U	100 U	100 U	67
277- 34 R08-SN01	66	100 U	100 U	100 U	100 U	100 U	100 U	100 U	111
277- 34 R08-SN01	66	100 U	100 U	100 U	100 U	100 U	100 U	100 U	157
277- 35 RO8-SN02	35	100 U	100 U	100 U	100 U	100 U	100 U	100 U	110
277- 36 R13-CBR1	92	100 U	100 U	100 U	100 U	100 U	100 U	100 U	119
277- 37 R01-MOR1	85	100 U	100 U	100 U	100 U	100 U	100 U	100 U	130
277- 38 R01-MOR2	88	100 U	100 U	100 U	100 U	100 U	100 U	100 U	70

U indicates not detected at detection limits sho

PAHS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

Battelle Code	Sponsor Code	% Moist.	Dibenzo-(a,h)-anthracene	Fluor-anthene	Fluorene	Indeno-1,2,3-Pyrene	2-Methyl-Naphthene	Naph-thalene	Phenan-threne	Pyrene
SEDIMENT										
277- 1	SED09-CB	60%	14	74	10 U	51	30	63	20	89
277- 2	SED07-CM	55%	15	120	10 U	87	12	26	45	160
277- 3	SED01-MR	47%	19	190	10 U	99	30	61	94	240
277- 4	SED05 CM	45%	10 U	10 U	10 U	10 U	15	34	10 U	10 U
277- 5	SED10 CB	72%	30	260	10 U	100	48	97	76	240
277- 6	SED13 CF	33%	10 U	49	10 U	14	17	35	20	46
277- 7	SED08 CM	38%	10 U	18	10 U	11	10 U	56	10 U	20
277- 8	SED14 BR	34%	10 U	28	10 U	17	30	59	13	33
277- 9	SED11 CB	32%	10 U	10 U	10 U	10 U	10 U	20 U	10 U	10 U
277- 10	SED04 CM	54%	11	110	10 U	77	25	50	42	140
277- 11	SED02-CM	49%	10	94	10 U	59	27	53	36	120
277- 12	SED03-CM	57%	10 U	54	10 U	43	35	64	25	72
277- 13	SEDWR09-CM	19%	69	490	72	320	20	37	460	630
PLANTS										
277- 14	08A-SAL	89%	10 U	10 U	10 U	10 U	30	90	16	10 U
277- 15	14C-SAL	89%	10 U	10 U	10 U	10 U	32	97	17	10 U
277- 16	08C-SAL	86%	10 U	10 U	10 U	10 U	25	68	20	10 U
277- 17	04C-SAL	90%	10 U	10 U	10 U	10 U	25	73	13	10 U
277- 18	03C-SAL	84%	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
277- 19	11C-SCI	90%	10 U	10 U	10 U	10 U	20 U	50 U	10	10 U
277- 20	11A-SCI	87%	10 U	10 U	10 U	10 U	24	60	18	10 U
277- 21	11B-SCI	86%	10 U	10 U	10 U	10 U	27	76	18	10 U
277- 22	03B-SPA	87%	10 U	10 U	10 U	10 U	29	88	14	10 U
277- 23	04A-SPA	87%	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
277- 24	14A-SCI	74%	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
277- 25	14D-SAL	81%	10 U	10 U	10 U	10 U	24	61	16	10 U
277- 26	02C-SAL	84%	10 U	10 U	10 U	10 U	24	59	22	10 U
277- 27	05D-SAL	87%	10 U	10 U	10 U	10 U	37	120	17	10 U
277- 28	03D-SAL	85%	10 U	10 U	10 U	10 U	28	83	15	10 U
277- 29	08D-SAL	87%	10 U	10 U	10 U	10 U	28	89	15	10 U
277- 30	08B-SAL	86%	10 U	10 U	10 U	10 U	20	60	12	10 U
277- 31	11D-SCI	88%	10 U	10 U	10 U	10 U	25	62	14	10 U
277- 32	03A-SPA	86%	10 U	10 U	10 U	10 U	24	68	14	10 U
277- 33	05A-SPA	84%	10 U	10 U	10 U	10 U	25	68	17	10 U

PAHS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

Battelle Code	Sponsor Code	% Moist.	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo[a] Anthra-cene	Benzo[b] Fluor-anthene	Benzo[k] Fluor-anthene	Benzo[a] pyrene	Benzo-(g,h,i)-perylene	Chrysene
SEDIMENT											
277- 1	SED09-CB	60%	10 U	10 U	17	56	83	67	62	65	76
277- 2	SED07-CM	55%	10 U	10 U	16	67	82	72	86	100	71
277- 3	SED01-MR	47%	12	15	38	100	96	82	130	110	100
277- 4	SED05-CM	45%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 5	SED10-CB	72%	19	120	97	150	211	150	130	110	300
277- 6	SED13-CF	33%	10 U	10 U	10 U	29	18	20	22	13	27
277- 7	SED08-CM	38%	10 U	10 U	10 U	10 U	15	11	11	15	15
277- 8	SED14-BR	34%	10 U	10 U	10 U	11	18	13	16	21	16
277- 9	SED11-CB	32%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 10	SED04-CM	54%	10 U	10 U	15	47	67	50	80	88	53
277- 11	SED02-CM	49%	10 U	10 U	15	41	58	44	63	68	51
277- 12	SED03-CM	57%	10 U	10 U	10 U	22	40	26	39	53	27
277- 13	SEDWR09-CM	19%	27	86	230	290	250	250	410	350	270
PLANTS											
277- 14	08A-SAL	89%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 15	14C-SAL	89%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 16	08C-SAL	86%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 17	04C-SAL	90%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 18	03C-SAL	84%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 19	11C-SCI	90%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 20	11A-SCI	87%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 21	11B-SCI	86%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 22	03B-SPA	87%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 23	04A-SPA	87%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 24	14A-SCI	74%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 25	14D-SAL	81%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 26	02C-SAL	84%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 27	05D-SAL	87%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 28	03D-SAL	85%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 29	08D-SAL	87%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 30	08B-SAL	86%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 31	11D-SCI	88%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 32	03A-SPA	86%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 33	05A-SPA	84%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

PAHS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

Battelle Code	Sponsor Code	% Moist.	Acenaph-thene	Acenaph-thylene	Anthra-cene	Benzo[a] Anthra-cene	Benzo[b] Fluor-anthene	Benzo[k] Fluor-anthene	Benzo[a] pyrene	Benzo-(g,h,i)-perylene	Chrysene
Tissue											
277- 34	R08-SN01	66%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 34 DUP	R08-SN01	66%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 35	RO8-SN02	35%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 36	R13-CBR1	92%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 37	R01-MOR1	85%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
277- 38	R01-MOR2	88%	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BLANK	BLANK	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
BLANK	BLANK	N/A	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

U indicates not detected at detection limit shown

PAHS IN SEDIMENTS, PLANTS & TISSUE

Sponsor: SIMMER (McGUFFIE)

(CONCENTRATIONS IN UG/KG WET WEIGHT)

Battelle Code	Sponsor Code	% Moist.	Dibenzo-(a,h)-anthracene	Fluor-anthene	Fluorene	Indeno-1,2,3-Pyrene	2-Methyl-Naphthene	Naph-thalene	Phenan-threne	Pyrene
TISSUE										
277- 34	R08-SN01	66%	10 U	10 U	10 U	10 U	30 U	60 U	10 U	10 U
277- 34 DUP	R08-SN01	66%	10 U	10 U	10 U	10 U	30 U	60 U	10 U	10
277- 35	RO8-SN02	35%	10 U	11	10 U	10 U	30 U	60 U	10 U	10 U
277- 36	R13-CBR1	92%	10 U	10 U	10 U	10 U	30 U	220	10 U	10 U
277- 37	R01-MOR1	85%	10 U	10 U	10 U	10 U	45	120	37	26
277- 38	R01-MOR2	88%	10 U	10 U	10 U	10 U	30 U	61	14	10 U
BLANK	BLANK	N/A	10 U	10 U	10 U	10 U	20 U	50 U	10 U	10 U
BLANK	BLANK	N/A	10 U	10 U	10 U	10 U	30 U	60 U	10 U	10 U

U indicates not detected at detection limit shown

Appendix C
Plant Test

Abbreviations

PB = Plant Bioassay

WRS or WRS1 = WES Reference Soil

PSC2 = Pinole Shoal Composite 2

PSC3 = Pinole Shoal Composite 3

WRC1 = West Richmond Composite 1

WT or WT15 = Wetland (15 ppt salinity)

WT0 = Wetland (0ppt salinity)

AD = Air Dried

ADW = Air Dried and Washed

SA = *Spartina alterniflora*

SV = *Sporobolis virginicus*

CE = *Cyperus esculentus*

LIST OF TABLES

	A	B	C	D	E	F	G	H	I
1		WES Laboratory Data For Baldwin Harbor Sediments							
2		pH, Electrical Conductivity, Moisture and Organic Matter							
3									
4									
5	SEDIMENT	STATUS	REP	pH	EC	H2O	OM		
6					mmhos/cm	%	%		
7	PSC2	WT	1	7.35	19.25	64.8	5.1		
8	PSC3	WT	1	7.31	17.69	53.8	4.9		
9	PSC4	WT	1	7.01	20.1	54.1	5.2		
10	PSC4	AD	1	7.35	25.3	2.9	4.8		
11	PSC4	ADW	1	7	9.28	1.9	4.7		
12	WRC1	WT	1	7.86	27.2	42.4	3.8		
13	WRC1	AD	1	7.63	37.5	1.6	4		
14	WRC1	ADW	1	7.39	5.28	2.1	3.3		
15	WRS1	AD	1	6.41	0.56	0.9	4		
16									
17	PSC2	WT	2	7.45	NA	65.4	5.3		
18	PSC3	WT	2	7.3	NA	58.6	5.4		
19	PSC4	WT	2	7.4	NA	54	5.4		
20	PSC4	AD	2	7.56	NA	4.9	5.6		
21	PSC4	ADW	2	7.1	NA	4.6	5.7		
22	WRC1	WT	2	7.92	NA	42.3	3.8		
23	WRC1	AD	2	7.79	NA	1.7	5.2		
24	WRC1	ADW	2	7.39	NA	2	3.8		
25	WRS1	AD	2	6.47	NA	1.6	5.2		
26									
27	PSC2	WT	3	7.43	NA	65.4	5.3		
28	PSC3	WT	3	7.35	NA	58.4	5		
29	PSC4	WT	3	7.37	NA	51.2	6.2		
30	PSC4	AD	3	7.44	NA	4.4	5.7		
31	PSC4	ADW	3	7	NA	3	5.1		
32	WRC1	WT	3	7.92	NA	41.4	4.9		
33	WRC1	AD	3	7.62	NA	2.5	4.1		
34	WRC1	ADW	3	7.4	NA	2.1	3.9		
35	WRS1	AD	3	6.05	NA	2.5	3.9		
36									
37	PSC2	WT	4	7.44	NA	66.7	5.6		
38	PSC3	WT	4	7.34	NA	57.8	5.6		
39	PSC4	WT	4	7.37	NA	57.1	5.3		
40	PSC4	AD	4	7.37	NA	4.7	4.9		
41	PSC4	ADW	4	7.1	NA	3	4.5		
42	WRC1	WT	4	7.87	NA	43.2	3.5		
43	WRC1	AD	4	7.61	NA	2.7	4.1		
44	WRC1	ADW	4	7.4	NA	2.1	3.3		
45	WRS1	AD	4	6.43	NA	3.5	3.1		
46									
47									
48		PSC2 = PINOLE SHOAL COMPOSITE 2							
49		PSC3 = PINOLE SHOAL COMPOSITE 3							
50		WRC1 = WEST RICHMOND COMPOSITE 1							
51		WRS1-= WES REFERENCE SOIL							
52									
53		WT = Wet							
54		AD= Air Dry							
55		ADW = Air Dry and Washed							
56									
57		REP = Replicate							
58									
59		OM = Organic Matter							
60		EC = Electrical Conductivity							
61									
62									
63									

BALDWIN HARBOR PLANT YIELDS
(GRAMS/POT)

OBS	SEDIMENT	STATUS	PLANT	REP	FRESH	OVEN-DRY
1	WRS1	WT15	SA	1	44.959	26.5264
2	WRS1	WT15	SA	2	53.758	29.0179
3	WRS1	WT15	SA	3	37.376	19.4634
4	WRS1	WT15	SA	4	41.561	20.9487
5	WRS1	WT0	SA	1	124.870	50.6000
6	WRS1	WT0	SA	2	74.970	32.8400
7	WRS1	WT0	SA	3	128.180	55.7855
8	WRS1	WT0	SA	4	85.419	38.8812
9	WRS1	AD	SA	1	44.531	16.3819
10	WRS1	AD	SA	2	37.588	17.2215
11	WRS1	AD	SA	3	40.560	12.1695
12	WRS1	AD	SA	4	39.102	8.1902
13	WRS1	AD	SV	1	40.679	18.6443
14	WRS1	AD	SV	2	44.152	19.5275
15	WRS1	AD	SV	3	33.303	21.7392
16	WRS1	AD	SV	4	20.454	20.6116
17	WRS1	AD	CE	1	93.840	18.5709
18	WRS1	AD	CE	2	79.030	15.6400
19	WRS1	AD	CE	4	69.520	13.7580
20	PSC2	WT	SA	1	36.658	21.7904
21	PSC2	WT	SA	4	26.674	14.1057
22	PSC3	WT	SA	1	23.518	12.2907
23	PSC3	WT	SA	2	12.111	6.1420
24	PSC3	WT	SA	3	33.050	17.8994
25	PSC3	WT	SA	4	18.124	9.6524
26	PSC4	AD	SV	1	38.085	19.6449
27	PSC4	AD	SV	3	26.876	13.7269
28	PSC4	AD	SV	4	17.845	8.8207
29	PSC4	ADW	SV	1	7.231	5.5462
30	PSC4	ADW	SV	2	7.420	5.6911
31	PSC4	ADW	SV	3	6.738	5.1680
32	PSC4	ADW	SV	4	7.084	5.4334
33	PSC4	ADW	CE	1	0.907	0.25740
34	PSC4	ADW	CE	2	2.635	0.74781
35	PSC4	ADW	CE	3	4.395	1.24730
36	PSC4	ADW	CE	4	6.362	1.80553
37	WRC1	WT	SA	1	5.180	1.94560
38	WRC1	WT	SA	2	5.300	1.99068
39	WRC1	WT	SA	3	2.265	0.85073
40	WRC1	AD	SV	1	0.000	0.00000
41	WRC1	AD	SV	2	0.000	0.00000
42	WRC1	AD	SV	3	0.000	0.00000
43	WRC1	AD	SV	4	0.000	0.00000
44	WRC1	ADW	SV	1	7.791	6.54132
45	WRC1	ADW	SV	2	8.694	7.29948
46	WRC1	ADW	SV	3	9.589	8.05092
47	WRC1	ADW	CE	3	3.379	0.73000

	A	B	C	D	E	F	G	H	I	J	K	L
1	SED	STATUS	REP	ug/g As	ug/g Cd	ug/g Cr	ug/g Cu	ug/g Pb	ug/g Ni	ug/g Se	ug/g Ag	ug/g Zn
2	PSC2	WT	R1	6.998	0.1	36.484	31.509	20.066	61.857	<0.332	<0.166	57.877
3	PSC2	WT	R2	7.197	0.332	44.113	33.167	22.056	64.511	<0.332	<0.166	74.461
4	PSC2	WT	R3	7.363	0.017	33.831	32.007	25.705	60.033	<0.332	<0.166	54.726
5	PSC2	WT	R4	8.076	0	30.846	34.328	22.222	55.224	<0.332	<0.166	54.726
6	PSC3	WT	R1	10.14	0	31.938	33.643	25.271	49.302	<0.31	<0.155	66.512
7	PSC3	WT	R2	9.318	0.14	32.558	33.488	22.946	51.008	<0.31	<0.155	63.566
8	PSC3	WT	R3	10.992	0	30.698	32.558	26.357	48.682	<0.31	0.667	57.984
9	PSC3	WT	R4	9.783	0	27.442	33.643	25.581	45.426	<0.31	<0.155	56.434
10	PSC4	AD	R1	7.568	0.156	35.031	32.328	21.206	57.069	<0.208	0.125	53.95
11	PSC4	AD	R2	7.422	<0.01	32.225	31.913	20.998	52.183	<0.208	<0.104	53.534
12	PSC4	AD	R3	7.266	0.114	32.744	32.225	21.102	54.262	<0.208	0.114	52.599
13	PSC4	AD	R4	6.996	0	28.586	40.852	23.909	48.96	<0.208	0.114	48.025
14	PSC4	ADW	R1	6.947	0	34.221	31.25	18.75	55.43	<0.205	<0.102	57.07
15	PSC4	ADW	R2	6.967	<0.01	31.762	30.43	23.258	52.561	<0.205	<0.102	52.869
16	PSC4	ADW	R3	6.24	0	30.328	30.328	20.902	51.537	<0.205	0.113	47.848
17	PSC4	ADW	R4	6.014	0.01	27.664	33.197	20.697	48.156	<0.205	<0.102	49.488
18	WRC1	AD	R1	6.286	0.173	29.082	17.857	19.184	43.878	<0.204	2.255	48.469
19	WRC1	AD	R2	6.184	<0.01	29.286	18.571	12.347	45	<0.204	<0.102	48.265
20	WRC1	AD	R3	6.398	0	25.102	17.959	18.367	40.714	<0.204	<0.102	42.653
21	WRC1	AD	R4	6.041	0	23.265	17.857	15.102	38.367	<0.204	<0.102	42.857
22	WRC1	ADW	R1	6.413	0	30.081	18.801	19.512	46.138	<0.203	0.102	49.085
23	WRC1	ADW	R2	5.783	<0.01	28.76	18.293	18.191	43.394	<0.203	<0.102	48.882
24	WRC1	ADW	R3	5.955	0	28.049	17.581	20.528	43.699	<0.203	<0.102	45.833
25	WRC1	ADW	R4	5.793	0	23.272	17.378	16.768	38.211	<0.203	0.498	40.955
26	WRS1	AD	R1	3.695	0.237	4.954	5.263	12.59	6.914	0.227	<0.103	18.266
27	WRS1	AD	R2	3.695	0.289	4.85	4.954	11.971	7.637	<0.206	0.743	20.227
28	WRS1	AD	R3	3.478	0.217	4.231	3.715	10.217	5.676	<0.206	<0.103	13.829
29	WRS1	AD	R4	3.488	0.217	4.541	4.644	7.843	4.954	<0.206	<0.103	13.416
30	NBS	1646	R1	7.281	0.35	25.129	13.491	29.145	16.684	0.556	0.124	96.601
31	NBS	1646	R2	7.662	0.36	25.438	13.697	33.059	17.405	0.577	1.751	99.073
32	NBS	1646	R3	7.302	0.33	24.614	13.8	31.411	16.787	0.577	0.103	97.94
33	NBS	1646	R4	7.003	0.371	22.554	13.903	27.6	14.831	0.536	<0.103	93.821
34	BLANK		R1	<0.0020	0.0001	<0.005 U	<0.005 U	<0.020 U	0.006 B	<0.0020	<0.0010	0.007 B
35	BLANK		R2	<0.0020	<0.0001	<0.005 U	<0.005 U	<0.020 U	<0.005 U	<0.0020	<0.0010	<0.005 U
36	BLANK		R3	<0.0020	0.0002	<0.005 U	<0.005 U	<0.020 U	<0.005 U	<0.0020	<0.0010	0.014 B
37	BLANK		R4	<0.0020	0.0004	<0.005 U	<0.005 U	<0.020 U	0.009 B	<0.0020	<0.0010	0.010 B
38												
39	NBS 1646 CERTIFIED VALUES			11.6	0.36	76	18	22.8	32	0.6	NA	138
40	% RECOVERY			63.0349089	97.9803181	32.149439	76.2387001	132.91145	51.3323893	93.5461723		70.1876147
41												
42	Cadmium values = 0 are a result of sample concentrations =/< Blank concentrations.											

BUTYLTIN CONCENTRATIONS IN PLANT TISSUE

(cf# 327)

(concentrations in ug/kg wet wt.)

Sponsor Code:		
Sample Number	METHOD BLANK *	
Sample ID	JL73PB	
Wet Weight (g)	1.000	MATRIX
Percent Dry Weight	NA	SPIKE
Dry Weight (g)	NA	%Recoveries
TBT	135.4	252.8 &
DBT	41.8	114.1
MBT	16.4 U	46.2
Surrogate:		
TPT %Recovery	39.7	59.5

U - Not detected, reported as MDL
J - Value below MDL

* Note: although blank value is high, it does not represent sample analyses and no blank corrections were made. High levels were assumed to be a result of a contaminted vial.

C8

BUTYLTIN CONCENTRATIONS IN PLANT TISSUE

(cf# 327)

(concentrations in ug/kg wet wt.)

Sponsor Code:	PSC4-ADW-SV-1234	WRC1-WT-SA-123	WRC1-ADW-SV-123	PSC4-AD-SV-1	DUPLICATE PSC4-AD-SV-1
Sample Number	327-40	327-41	327-42	327-35	327-35
Sample ID	327-40	327-41	327-42	327-35	327-35DUP
Wet Weight (g)	2.341	1.004	2.128	2.130	2.100
Percent Dry Weight	NA	NA	NA	NA	NA
Dry Weight (g)	NA	NA	NA	NA	NA
TBT	38.3 U	38.3 U	38.3 U	38.3 U	14.9 J
DBT	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U
MBT	9.2 J	16.4 U	16.4 U	16.4 U	16.4 U
Surrogate:					
TPT %Recovery	46.4	49.9	54.9	40.7	68.0

U - Not detected, reported as MDL
J - Value below MDL

BUTYLTIN CONCENTRATIONS IN PLANT TISSUE
(cf# 327)

(concentrations in ug/kg wet wt.)

Sponsor Code:	PSC3-WT-SA-4	PSC4-AD-SV-3	PSC4-AD-SV-4	PSC4-ADW-SV-14	PSC4-ADW-SV-23
Sample Number	327-34	327-36	327-37	327-38	327-39
Sample ID	327-34	327-36	327-37	327-38	327-39
Wet Weight (g)	1.009	2.260	1.540	1.570	1.617
Percent Dry Weight	45.92	NA	NA	NA	NA
Dry Weight (g)	0.463	NA	NA	NA	NA
TBT	38.3 U	38.3 U	38.3 U	38.3 U	38.3 U
DBT	33.5 J	18.1 U	18.1 U	18.1 U	18.1 U
MBT	16.4 U	16.4 U	16.4 U	16.4 U	16.4 U
Surrogate:					
TPT %Recovery	45.9	57.7	50.6	52.9	58.1

U - Not detected, reported as MDL
J - Value below MDL

BUTYLTIN CONCENTRATIONS IN PLANT TISSUE
(cf# 327)

(concentrations in ug/kg wet wt.)

Sponsor Code:	PSC2-WT-SA-1	PSC2-WT-SA-4	PSC3-WT-SA-1	PSC3-WT-SA-2	PSC3-WT-SA-3
Sample Number	327-29	327-30	327-31	327-32	327-33
Sample ID	327-29	327-30	327-31	327-32	327-33
Wet Weight (g)	2.007	1.527	1.526	1.011	2.026
Percent Dry Weight	42.89	44.16	41.22	41.98	44.46
Dry Weight (g)	0.861	0.674	0.629	0.424	0.901
TBT	38.3 U	38.3 U	38.3 U	38.3 U	38.3 U
DBT	18.1 U	18.1 U	18.1 U	18.1 U	18.1 U
MBT	16.4 U	16.4 U	16.4 U	16.4 U	16.4 U
Surrogate:					
TPT %Recovery	45.1	50.3	61.1	42.7	48.5

U - Not detected, reported as MDL
J - Value below MDL

PAH CONCENTRATIONS IN PLANT *
(cf# 327)

Sponsor Code:	PSC4-ADW-SV-1234	WRC1-WT-SA-123	WRC1-ADW-SV-123	MATRIX SPIKE RESULTS
Sample Number	327-40	327-41	327-42	SAMPLE SPIKED: 327-29
Species	Plant	PLANT	PLANT	
Wet Weight(g)	9.123	4.382	8.427	PERCENT RECOVERY
PAHs				
(Concentrations in ug/kg wet wt.)				
naphthalene	51.08 B	27.18 B	10.22 B	119%
acenaphthylene	4.4 U	9.16 U	6.25	134%
acenaphthene	2.38 U	4.95 U	2.57 U	93%
fluorene	1.84 J	2.74 J	2.51 J	82%
phenanthrene	2.00 U	3.81 B	5.18 B	82%
anthracene	1.95 U	4.06 U	2.11 U	80%
fluoranthene	0.57 J	4.64	4.75	74%
pyrene	0.54 J	3.19 J	4.34	74%
benz[a]anthracene	3.25 U	6.77 U	3.52 U	74%
chrysene	2.28 U	4.75 U	2.23 J	61%
benzo[b]fluoranthene	3.32 U	6.91 U	3.59 U	78%
benzo[k]fluoranthene	2.78 U	5.79 U	3.01 U	76%
benzo[a]pyrene	2.9 U	6.03 U	3.14 U	120% M
indeno[1,2,3-c,d]pyrene	3.47 U	7.23 U	3.76 U	98%
dibenz[a,h]anthracene	2.36 U	4.92 U	2.56 U	97%
benzo[g,h,i]perylene	4.71 U	9.8 U	5.1 U	100%
Surrogate Percent Recoveries				
naphthalene-d8 (% Rec)	45.19	86.39	58.36	74.14
acenaphthene-d10 (% Rec)	131 M&	154.04 M&	120.17 M&	134.55 M&
benzo[a]pyrene-d12 (% Rec)	81.37	110.39	104.7	87.64

B Indicates sample has been corrected for blank concentration
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference
& - Surrogate Recovery out of QC range (40 - 120%)

PAH CONCENTRATIONS IN PLANT *
(cl# 327)

Sponsor Code:	PSC4-AD-SV-1	DUPLICATE PSC4-AD-SV-1	PSC4-AD-SV-3	PSC4-AD-SV-4	PSC4-ADW-SV-14	PSC4-ADW-SV-23
Sample Number	327-35	327-35	327-36	327-37	327-38	327-39
Species	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT
Wet Weight(g)	7.431	5.744	8.866	5.025	4.212	4.271
PAHs						
(Concentrations in ug/kg wet wt.)						
naphthalene	5.00 U	12.67 B	5.00 U	5.00 U	53.90 B	18.60 B
acenaphthylene	5.4 U	6.99 U	4.53 U	7.99 U	9.53 U	9.4 U
acenaphthene	2.92 U	3.77 U	2.45 U	4.31 U	5.15 U	5.08 U
fluorene	3.16 U	2 J	2.65 U	1.48 J	2.99 J	5.5 U
phenanthrene	2.00 U	3.95 B	2.00 U	2.00 U	7.81 B	3.51 B
anthracene	2.39 U	3.09 U	2 U	3.54 U	4.22 U	4.16 U
fluoranthene	2.47	2.3 J	2.04	1.75 J	4.13	9.08
pyrene	1.31 J	1.92 J	1.12 J	4.21 U	3.68 J	20.22
benz[a]anthracene	3.99 U	5.17 U	3.35 U	5.91 U	7.05 U	6.95 U
chrysene	1.13 J	3.62 U	2.35 U	4.14 U	2.15 J	1.79 J
benzo[b]fluoranthene	4.08 U	5.27 U	3.42 U	6.03 U	7.19 U	7.09 U
benzo[k]fluoranthene	3.41 U	4.42 U	2.86 U	5.05 U	6.02 U	5.94 U
benzo[a]pyrene	3.56 U	4.6 U	2.98 U	5.26 U	6.27 U	6.19 U
indeno[1,2,3-c,d]pyrene	4.26 U	5.51 U	3.57 U	6.3 U	7.52 U	7.42 U
dibenz[a,h]anthracene	2.9 U	3.75 U	2.43 U	4.29 U	5.11 U	5.04 U
benzo[g,h,i]perylene	5.78 U	7.48 U	4.84 U	8.55 U	10.2 U	10.06 U
Surrogate Percent Recoveries						
naphthalene-d8 (% Rec)	95.43	81.57	76.49	101.1	57.24	71.14
acenaphthene-d10 (% Rec)	188.4 M&	155.91 M&	170.84 M&	178.59 M&	137.95 M&	148.56 M&
benzo[a]pyrene-d12 (% Rec)	115.8	102.05	111.64	108.07	107.75	116.26

B Indicates sample has been corrected for blank concentration
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference
& - Surrogate Recovery out of QC range (40 - 120%)

PAH CONCENTRATIONS IN PLANT TISSUE
(cl# 327)

Sponsor Code:	method blank	PSC2-WT-SA-1	PSC2-WT-SA-4	PSC3-WT-SA-1	PSC3-WT-SA-2	PSC3-WT-SA-3	PSC3-WT-SA-4
Sample Number	JL79PB	327-29	327-30	327-31	327-32	327-33	327-34
Species	NA	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT
Wet Weight(g)	10.000	9.967	9.722	8.279	4.068	13.098	6.552
PAHs							
(Concentrations in ug/kg wet wt.)							
naphthalene	10.758	5.23 B	7.42 B	7.26 B	15.12 B	8.27 B	5.00 U
acenaphthylene	4.014 U	4.03 U	4.13 U	4.85 U	9.87 U	3.07 U	6.13 U
acenaphthene	2.168 U	2.18 U	2.23 U	2.62 U	5.33 U	1.66 U	3.31 U
fluorene	0.957 J	1.59 J	1.01 J	1.49 J	2.79 J	1.08 J	2.03 J
phenanthrene	2.465	2.00 U	2.00 U	2.00 U	3.91 B	3.49 B	2.00 U
anthracene	1.777 U	1.78 U	1.83 U	2.15 U	4.37 U	1.36 U	2.71 U
fluoranthene	1.727 U	2.27	2.04	1.75 J	3.47 J	1.64	2.37 J
pyrene	2.117 U	2.23	2.02 J	1.4 J	3.38 J	1.68	2.15 J
benz[a]anthracene	2.968 U	1.52 J	3.05 U	3.59 U	7.3 U	2.27 U	4.53 U
chrysene	2.080 U	1.46 J	2.14 U	2.51 U	5.11 U	1.59 U	3.18 U
benzo[b]fluoranthene	3.029 U	6.41	3.12 U	3.66 U	7.45 U	2.31 U	4.62 U
benzo[k]fluoranthene	2.537 U	3	2.61 U	3.06 U	6.24 U	1.94 U	3.87 U
benzo[a]pyrene	2.642 U	2.65 U	2.72 U	3.19 U	6.5 U	2.02 U	4.03 U
indeno[1,2,3-c,d]pyrene	3.167 U	4.82	3.26 U	3.83 U	7.79 U	2.42 U	4.83 U
dibenz[a,h]anthracene	2.154 U	2.16 U	2.22 U	2.6 U	5.3 U	1.65 U	3.29 U
benzo[g,h,i]perylene	4.295 U	4.31 U	4.42 U	5.19 U	10.56 U	3.28 U	6.56 U
Surrogate Percent Recoveries							
naphthalene-d8 (% Rec)	75.15	83.16	86.33	74.23	83.85	83.54	87.22
acenaphthene-d10 (% Rec)	87.62 M	160.45 M&	168.33 M&	143.29 M&	167.57 M&	145.9 M&	142.26 M&
benzo[a]pyrene-d12 (% Rec)	35.46 &	84.79	98.65	82.35	106.49	103.14	116.52

B Indicates sample has been corrected for blank concentration
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference
& - Surrogate Recovery out of QC range (40 - 120%)

JOB DESCRIPTION: OAKLAND INN/OUT - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: COEED38301E000F
TYPE OF SAMPLE: PLANT TISSUE

RECEIPT DATE: 28
EST. COMP. DATE: 05

COLUMN.......... 1
ANALYTE......... 8
MG/KG........... HG

SAMP #	DESCRIPTION		
13153	OAKOUT-WT-SA-124	CONC	0.045
		%REC	
		DUPL	
		OID	56651205
13154	OAKOUT-ADW-SV-12	CONC	<0.032
		%REC	
		DUPL	0.032
		OID	56651205
13155	OAKOUT-ADW-SV-34	CONC	<0.032
		%REC	
		DUPL	0.043
		OID	56651205
13156	OAKOUT-ADW-CE-124	CONC	<0.032
		%REC	
		DUPL	0.032
		OID	56651205

HG Mercury

JOB DESCRIPTION: OAKLAND INN/OUT - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: CQEED38301E000F
TYPE OF SAMPLE: PLANT TISSUE

RECEIPT DATE: 28
EST. COMP. DATE: 05

COLUMN......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
13147	WRS-AD-SV-3	CONC	0.032
		%REC	
		DUPL	0.032
		OID	56651205
13148	WRS-AD-CE-1234	CONC	0.032
		%REC	
		DUPL	0.032
		OID	56651205
13149	WRS-AD-SV-4	CONC	<0.027
		%REC	72.0
		DUPL	<0.027
		OID	56651205
13150	OAKINN-WR-SA-134	CONC	<0.032
		%REC	
		DUPL	0.032
		OID	56651205
13151	OAKINN-ADW-SV-1234	CONC	<0.032
		%REC	
		DUPL	<0.032
		OID	56651205
13152	OAKINN-ADW-CE-1234	CONC	<0.032
		%REC	64.0
		DUPL	<0.032
		OID	56651205

HG Mercury

JOB FILE: 13141

DATE: 27

****************************** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 1 OF 3) **********************

JOB DESCRIPTION: OAKLAND INN/OUT - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: COEED38301E000F
TYPE OF SAMPLE: PLANT TISSUE

RECEIPT DATE: 28
EST. COMP. DATE: 05

COLUMN.......... 1
ANALYTE......... 8
MG/KG........... HG

SAMP #	DESCRIPTION		
13141	WRS-WT15-SA-1	CONC	<0.032
		%REC	128.0
		DUPL	<0.032
		OID	56651205
13142	WRS-WT15-SA-2	CONC	0.032
		%REC	
		DUPL	<0.032
		OID	56651205
13143	WRS-WT15-SA-3	CONC	<0.032
		%REC	
		DUPL	<0.032
		OID	56651205
13144	WRS-WT15-SA-4	CONC	<0.032
		%REC	
		DUPL	
		OID	56651205
13145	WRS-AD-SV-1	CONC	0.032
		%REC	
		DUPL	0.032
		OID	56651205
13146	WRS-AD-SV-2	CONC	<0.032
		%REC	
		DUPL	<0.032
		OID	56651205

HG Mercury

JOB DESCRIPTION: BALDWIN - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: CQ07938301E0001
TYPE OF SAMPLE: PLANT TISSUE

RECEIPT DATE: .d
EST. COMP. DATE: 05

COLUMN......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
13132	WRC1-WT-SA-123	CONC	<0.032 #1
		%REC	
		DUPL	
		OID	56651204
13133	PSC4-AD-SV-1	CONC	0.029
		%REC	79.1
		DUPL	0.056
		OID	56651204
13134	PSC4-AD-SV-3	CONC	<0.030
		%REC	92.0
		DUPL	<0.030
		OID	56651204
13135	PSV4-AD-SV-4	CONC	<0.030
		%REC	
		DUPL	<0.030
		OID	56651204
13136	PSC4-ADW-SV-14	CONC	0.031
		%REC	
		DUPL	0.034
		OID	56651204
13137	PSC4-ADW-SV-23	CONC	<0.030
		%REC	
		DUPL	<0.030
		OID	56651204

HG Mercury

FOOTNOTES:
#1 Sample digest from sample No. 13087.

****************************** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 1 OF 3) ****************

JOB DESCRIPTION: BALDWIN - R. PRICE

CHEM. PRESERVATIVE:

JOB NUMBER: C007938301E0001

TYPE OF SAMPLE: PLANT TISSUE

RECEIPT DAT

EST. COMP. DAT

COLUMN.......... 1

ANALYTE........ 8

MG/KG.......... HG

SAMP #	DESCRIPTION		
13126	PSC2-WT-SA-1	CONC	0.048
		%REC	
		DUPL	0.057
		OID	56651204
13127	PSCA-WT-SA-4	CONC	0.048
		%REC	
		DUPL	0.045
		OID	56651204
13128	PSC3-WT-SA-1	CONC	<0.029
		%REC	
		DUPL	
		OID	56651204
13129	PSC3-WT-SA-2	CONC	<0.029
		%REC	
		DUPL	
		OID	56651204
13130	PSC3-WT-SA-3	CONC	<0.029
		%REC	
		DUPL	0.029
		OID	56651204
13131	PSC3-WT-SA4	CONC	<0.029
		%REC	
		DUPL	0.037
		OID	56651204

HG Mercury

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
46	Blanks above detection limits were subtracted from sample concentrations.													
47	Concentrations of 0 were less than blank concentrations.													
48	NBS 1572 Concentrations for Cd, Ni, and Se were near or below detection limits; % recovery was not determined.													
49	NA=Not available													
50	ND = Not determined													

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	SED	STATUS	PLANT	PL REP	DIG REP	ug/g As	ug/g Cd	ug/g Cr	ug/g Cu	ug/g Pb	ug/g Ni	ug/g Se	ug/g Ag	ug/g Zn
2	WRS1	WT	SA	1		<1	0	<1	3.8	3.6	1.2	0	<0.2	14.6
3	WRS1	WT	SA	2		<0.998	0.06	<0.998	2.794	4.391	1.198	0	<0.2	8.583
4	WRS1	WT	SA	3		<0.996	0.08	<0.996	2.988	3.785	1.594	0	<0.2	10.558
5	WRS1	WT	SA	4		<0.994	0	<0.994	3.579	4.573	1.392	25.05	<0.2	10.537
6	WRS1	AD	SV	1		<0.996	0.159	<0.996	2.59	0	1.394	0	<0.2	2.789
7	WRS1	AD	SV	2		<0.994	0.139	<0.994	2.386	0	1.59	0	<0.2	1.193
8	WRS1	AD	SV	3		<0.994	0.08	<0.994	2.187	0	0.994	0	<0.2	5.964
9	WRS1	AD	CE	1234		<0.994	1.789	<0.994	8.748	0.199	1.59	0	<0.2	68.588
10	WRS1	AD	CE	1234		<0.992	1.845	<0.992	8.532	0	1.786	0	<0.2	77.183
11	WRS1	AD	CE	1234		<0.994	1.511	<0.994	8.151	0.199	1.988	0	<0.2	75.746
12	BLANK					<0.005	<0.0001	<0.005	<0.005	0.003	<0.005	<0.005	<0.0010	0.047
13	NBS	1572		1		3.579	0	0.557	14.314	13.718	<0.994	0	<0.2	27.634
14														
15														
16														
17	PSC2	WT	SA	1		<0.994	0.02	<0.994	4.771	0	0	0.994	<0.199	13.917
18	PSC2	WT	SA	4		<1.002	0	<1.002	4.008	5.21	0	<1.002	<0.2	15.03
19	PSC3	WT	SA	1		<0.992	0	<0.992	3.175	0	0	<0.992	<0.198	14.683
20	PSC3	WT	SA	2		<0.992	0	<0.992	2.976	0	0.198	1.19	<0.198	18.651
21	PSC3	WT	SA	3	R1	<0.992	0	<0.992	2.778	3.175	0.397	<0.992	<0.198	11.31
22	PSC3	WT	SA	3	R2	<0.99	0	<0.99	3.168	0	0.396	<0.99	<0.198	11.089
23	PSC3	WT	SA	3	R3	<0.988	0	<0.988	3.162	1.976	0.198	<0.988	<0.198	11.462
24	PSC3	WT	SA	4		<0.996	0	<0.996	5.179	0	0	<0.996	<0.199	11.355
25	WRC1	WT	SA	123		<1.188	0	<1.188	3.325	3.325	0	<1.188	<0.238	9.739
26	PSC4	AD	SV	1		<0.996	0.398	<0.996	4.98	0	1.195	<0.996	<0.199	27.689
27	NBS	1572		3		3.168	0.04	0.614	14.653	18.218	0.198	<0.99	<0.198	24.752
28	BLANK			3		<0.005	<0.0003	<0.005	<0.005	0.010	0.005	<0.005	<0.0010	<0.006 U
29														
30	PSC4	AD	SV	3		<0.99	0.535	<0.99	5.149	0.198	1.782	<0.99	<0.198	34.059
31	PSC4	AD	SV	4		<0.99	0.554	0.99	5.941	0.198	2.97	<0.99	<0.198	40.792
32	PSC4	ADW	SV	14		<0.992	0.02	<0.992	8.135	4.167	1.19	<0.992	<0.198	33.929
33	PSC4	ADW	SV	23		<0.994	<0.02	<0.994	10.537	0.199	1.59	<0.994	<0.199	42.942
34	PSC4	ADW	CE	1234		<1	0.62	<1	10.2	4.2	2.6	67.4	<0.2	95.4
35	WRC1	ADW	SV	123	R1	<0.998	<0.02	<0.998	5.788	0.399	1.597	<0.998	<0.2	31.337
36	WRC1	ADW	SV	123	R2	<0.994	<0.02	<0.994	7.356	0	1.193	<0.994	<0.199	35.388
37	WRC1	ADW	SV	123	R3	<0.992	<0.02	<0.992	5.556	0	0.992	<0.992	<0.198	29.365
38	WRC1	ADW	CE	2		<0.996	0.1	1.394	13.944	0.598	3.187	199.203	<0.199	118.127
39	BLANK			4		<0.005	<0.0001	<0.005	<0.005	0.002	<0.005	<0.005	<0.0010	0.006
40	NBS	1572		4		3.194	<0.02	0.559	14.97	16.567	2.794	<0.998	<0.2	25.749
41														
42	CERTIFIED VALUE					3.1	0.03	0.8	16.5	13.3	0.6	0.025	NA	29
43	% Recovery		1572	1		115	ND	69.6	86.8	103	ND	ND		95.3
44			1572	3		102	133	76.8	88.8	137	33	ND		85.4
45			1572	4		103.032258	ND	69.9	90.7	125	465	ND		88.8

10/28/91

WES JF BALDWIN (CF #327)
ORGANOTIN ANALYSIS OF SEDIMENT

(concentrations in ug/kg dry weight)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Tetra Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
METHOD BLANK RESULTS						
327-BLANK-1		79.31	0.5 U	0.5 U	0.5 U	0.4 U
327-BLANK-2		77.16	0.5 U	0.6	0.5 U	0.4 U
327-BLANK-3		79.18	0.4 U	0.4	0.4 U	0.3 U
327-BLANK-4		90.63	0.4 U	0.6	0.4 U	0.4 U
BLANK AND MATRIX SPIKE RECOVERIES						
327-1-SPIKE		75.19	0.6 U	0.8	1.0	0.6 U
% Recovery			54.2%	49.5%	50.8%	24.0%
327-20-SPIKE		91.54	64.3	62.3	62.3	10.6
% Recovery			64.5%	62.4%	62.5%	10.3%

10/28/91

WES JF BALDWIN (CF #327)

ORGANOTIN ANALYSIS OF SEDIMENT

(concentrations in ug/kg dry weight)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Tetra Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
327-1	PB-PSC2-WT-R1	75.19	0.6 U	0.8	1.0	0.6 U
327-2	PB-PSC2-WT-R2	70.11	0.6 U	0.8	0.6 U	0.6 U
327-3	PB-PSC2-WT-R3	87.23	0.7 U	2.9	1.7	0.8
327-4	PB-PSC2-WT-R4	80.12	0.6 U	0.8	0.6 U	0.5 U
327-5	PB-PSC3-WT-R1	68.53	0.5 U	1.3	0.5 U	0.5 U
327-6	PB-PSC3-WT-R2	79.04	0.5 U	0.9	0.5 U	0.5 U
327-7	PB-PSC3-WT-R3	84.35	0.6 U	0.8	0.6 U	0.5 U
327-8	PB-PSC3-WT-R4	84.91	0.6 U	0.9	0.6 U	0.5 U
327-9	PB-PSC4-AD-R1	84.56	0.5 U	0.5 U	0.5 U	0.5 U
327-10A	PB-PSC4-AD-R2	87.09	1.3	0.6	0.5 U	0.4 U
327-10B	PB-PSC4-AD-R2	81.11	0.4 U	0.4 U	0.4 U	0.4 U
327-11	PB-PSC4-AD-R3	90.67	1.4	0.6	0.5 U	0.4 U
327-12	PB-PSC4-AD-R4	93.65	0.5 U	0.6	0.5 U	0.4 U
327-13	PB-PSC4-AWD-R1	84.37	0.4 U	0.6	0.4 U	0.4 U
327-14	PB-PSC4-AWD-R2	82.53	0.5 U	0.6	0.5 U	0.4 U
327-15	PB-PSC4-ADW-R3	75.86	0.8 U	0.6	0.4 U	0.4 U
327-16	PB-PSC4-ADW-R4	82.19	0.4 U	0.6	0.4 U	0.4 U
327-17	PB-WRCI-AD-R1	89.5	0.5 U	0.6	0.5 U	0.4 U
327-18	PB-WRCI-AD-R2	88.3	0.5 U	0.5	0.5 U	0.4 U
327-19	PB-WRCI-AD-R3	108.38	0.5 U	0.6	0.5 U	3.3
327-20	PB-WRCI-AD-R4	85.98	0.4 U	0.5	0.4 U	0.4 U
327-21	PB-WRCI-ADW-R1	91.88	1.0	0.6	0.4 U	0.3 U
327-22	PB-WRCI-ADW-R2	69.21	0.4 U	0.6	0.4 U	0.4 U
327-23-R	PB-WRCI-ADW-R3	88.31	0.4 U	0.6	0.4 U	0.3 U
327-24-R	PB-WRCI-ADW-R3	81.47	0.4 U	0.6	0.4	0.3 U
327-25	PB-WRS-AD-R1	49.18	0.4 U	0.8	0.4 U	2.0
327-26	PB-WRS-AD-R2	64.53	0.3 U	0.4 U	0.3 U	0.3 U
327-27	PB-WRS-AD-R3	74.87	0.4 U	0.4 U	0.4 U	0.3 U
327-28A	PB-WRS-AD-R4	68.54	0.3 U	0.3 U	0.3 U	0.3 U
327-28B	PB-WRS-AD-R4	68.62	0.4 U	0.4 U	0.4 U	0.7

U = Indicates analyte not detected above detection limits.

9/20/91
WES BALDWIN (CF#327)

MATRIX SPIKE RECOVERIES

(concentrations in ug/kg dry weight)

	Naph-thalene	Flourene	Anthra-cene	Flour-anthene	Benz[a]-anthracene	Benzo[a] pyrene	Benzo[ghi]-perylene
LAB SPIKE I							
Spike Added	91	91	91	91	91	91	91
Spike Recovered	31	29	27	35	35	31	42
Percent Recovery	34% *	32% *	29% *	38% *	39% *	34% *	46% *
LAB SPIKE I DUP							
Spike Added	91	91	91	91	91	91	91
Spike Recovered	74	77	74	86	88	78	89
Percent Recovery	81% *	85% *	82% *	95% *	97% *	85% *	98% *
LAB SPIKE II							
Spike Added	96	96	96	96	96	96	96
Spike Recovered	85	90	85	103	86	88	93
Percent Recovery	85%	94%	88%	107%	90%	91%	97%
LAB SPIKE II DUP							
Spike Added	100	100	100	100	100	100	100
Spike Recovered	84	87	81	102	84	85	89
Percent Recovery	84%	87%	81%	102%	84%	85%	89%

* Values outside of QC limits.

10/28/91
WES BALDWIN (CF#327)

PAH CONCENTRATIONS IN SEDIMENT DATA

(concentrations in ug/kg dry weight)

Client ID	Sponsor Code	Sample ID	Chrysene	Benzo(b)-Benzo(k)-Flouranthene	Benzo(a)-Pyrene	Indeno-(1,2,3-cd) Pyrene	Dibenz(a,h)-Anthracene	Benzo(ghi) Perylene	% Surrogate Recovery D10 Flourene	D10 Anthracene	D10 Pyrene
LAB SPIKE I		Lab Spike	40.3	73.3	31.2	42.1	39.1	42.1	30.2	28.4	35.0
LAB SPIKE DUP		Lab Spike Dup	89.9	188.2	77.7	90.6	92.6	88.7	80.3	80.9	87.8
LAB SPIKE II		Lab Spike	92.1	195.7	87.9	102.2	98.1	93.4	86.4	82.4	92.7
LAB SPIKE DUP		Lab Spike Dup	89.9	199.2	85.0	98.2	94.1	88.9	79.5	74.3	87.1
Lab Method Blank I		Blank	3.8 U	7.5 U	3.8 U	3.8 U	3.8 U	3.8 U	91.6	86.1	97.4
Lab Method Blank II		Blank	3.9 U	7.8 U	3.9 U	3.9 U	3.9 U	3.9 U	73.1	68.4	76.3
Lab Method Blank III		Blank	3.8 U	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	72.1	58.3	88.1

U = Indicates compound was analyzed for but not detected.
B = This flag is used when the analyte is found in the associated blank as well as in the sample.
D = This flag identifies all compounds identified in an analysis at a secondary dilution factor.

327pah.SEDdata

10/28/91
WES BALDWIN (CF#327)

PAH CONCENTRATIONS
IN SEDIMENT DATA

(concentrations in ug/kg dry weight)

Client ID	Sponsor Code	Sample ID	Chrysene	Benzo(b)-Benzo(k)-Flouranthene	Benzo(a)-Pyrene	Indeno-(1,2,3-cd) Pyrene	Dibenz(a,h)-Anthracene	Benzo(ghi) Perylene	% Surrogate Recovery D10 Flour-ene	D10 Anth-racene	D10 Py-rene
327-1	PB-PSC2-WT-R1	249259	5.2 U	10.4 U	5.2 U	5.2 U	5.2 U	6.3	84.0	96.0	91.2
327-2	PB-PSC2-WT-R2	249260	5.9 U	11.7 U	5.9 U	5.9 U	5.9 U	5.9 U	80.8	101.1	93.7
327-3	PB-PSC2-WT-R3	249261	5.5 U	11.1 U	7.2	6.8	5.5 U	7.9	78.8	97.2	95.4
327-4	PB-PSC2-WT-R4	249262	5.3	15.5	12.3	10.5	5.3 U	13.7	87.3	105.9	99.9
327-5	PB-PSC3-WT-R1	249263	13.4	34.2	24.9	21.6	5.6 U	27.4	82.4	98.5	93.1
327-6	PB-PSC3-WT-R2	249264	7.3	22.3	13.5	11.8	5.8 U	14.8	85.5	103.1	98.8
327-7	PB-PSC3-WT-R3	249265	6.7	14.8	10.8	8.5	5.5 U	11.1	82.8	98.4	95.4
327-8	PB-PSC3-WT-R4	249266	14.4	40.2	23.6	20.9	5.4 U	23.0	81.0	92.2	92.6
327-9	PB-PSC4-AD-R1	249267	8.8	17.2	11.3	10.0	3.7 U	11.8	76.5	88.6	89.5
327-10	PB-PSC4-AD-R2	249268	8.8	21.7	11.6	7.6	4.0 U	12.4	84.5	91.5	84.7
327-11	PB-PSC4-AD-R3	249269	7.1	13.4	9.4	7.2	3.9 U	10.9	83.2	93.0	89.2
327-12	PB-PSC4-AD-R4	249270	7.5	11.3	9.2	7.5	3.9 U	11.5	83.7	91.1	86.7
327-13	PB-PSC4-ADW-R1	249271	9.3	16.7	9.1	6.4	3.8 U	10.8	81.4	93.0	85.6
327-14	PB-PSC4-ADW-R2	249272	7.4	17.5	10.3	5.9	3.8 U	8.6	87.2	97.3	85.7
327-15	PB-PSC4-ADW-R3	249273	5.8	8.0 U	4.0 U	4.0 U	4.0 U	4.0 U	85.0	94.4	84.1
327-16	PB-PSC4-ADW-R4	249274	7.6	14.1	10.5	5.7	4.0 U	8.2	86.2	93.7	83.5
327-17 DL	PB-WRC1-AD-R1	249275 1:10 DIL	292.8 D	476.1 D	647.2 D	291.3 D	49.0 D	440.7 D	82.0	80.1	94.8
327-18 DL	PB-WRC1-AD-R2	249276 1:10 DIL	239.4 D	504.2 D	742.7 D	354.1 D	42.8 D	417.2 D	85.2	80.0	94.5
327-19 DL	PB-WRC1-AD-R3	249277 1:10 DIL	180.9 D	386.4 D	523.2 D	239.7 D	39.0 UD	307.9 D	83.1	79.1	95.6
327-20 DL	PB-WRC1-AC-R4	249278 1:10 DIL	390.9 D	767.2 D	1122.9 D	423.2 D	60.1 D	497.0 D	80.9	73.9	91.9
327-21 DL	PB-WRC1-ADW-R1	249279 1:10 DIL	228.1 D	458.6 D	573.8 D	291.2 D	39.2 UD	295.4 D	85.4	71.8	103.0
327-22 DL	PB-WRC1-ADW-R2	249280 1:10 DIL	175.4 D	524.7 D	594.9 D	388.3 D	43.3 D	431.8 D	66.1	48.3	83.2
327-23 DL	PB-WRC1-ADW-R3	249281 1:10 DIL	269.6 D	551.2 D	648.7 D	354.9 D	42.9 D	353.6 D	80.5	66.1	96.3
327-24 DL	PB-WRC1-ADW-R4	249282 1:10 DIL	255.6 D	505.1 D	612.5 D	302.5 D	39.2 UD	324.9 D	81.9	70.4	99.2
327-25	PB-WRS-AD-R1	249283	3.8 U	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	82.1	75.3	90.6
327-26	PB-WRS-AD-R2	249284	6.9	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	84.2	79.2	91.9
327-27	PB-WRS-AD-R3	249285	3.8 U	7.7 U	3.8 U	3.8 U	3.8 U	3.8 U	78.2	68.0	86.2
327-28	PB-WRS-AD-R4	249286	4.0 U	8.0 U	4.0 U	4.0 U	4.0 U	4.0 U	65.0	53.6	69.9

327pah.SEDdata

10/28/91

WES BALDWIN (CF#327)

PAH CONCENTRATIONS IN SEDIMENT DATA

(concentrations in ug/kg dry weight)

Client ID	Sponsor Code	Sample ID	Naph-thalene	Acenaph-thylene	Acenaph-thene	Flourene	Phenan-threne	Anthra-cene	Flouran-thene	Pyrene	Benzo(a)-Anthracene
LAB SPIKE I		Lab Spike	30.7 B	17.2	30.5	29.1	30.0	26.5	34.8	32.0	35.4
LAB SPIKE DUP		Lab Spike Dup	74.1 B	71.4	78.1	77.2	73.1	74.2	86.2	79.7	88.4
LAB SPIKE II		Lab Spike	84.6 B	93.2	87.2	90.0	88.6	84.8	103.0	92.1	86.3
LAB SPIKE DUP		Lab Spike Dup	84.2 B	87.2	84.4	87.0	86.6	80.6	101.7	90.1	83.9
Lab Method Blank I		Blank	5.8	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U
Lab Method Blank II		Blank	5.0	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
Lab Method Blank III		Blank	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U

U = Indicates compound was analyzed for but not detected.

B = This flag is used when the analyte is found in the associated blank as well as in the sample.

D = This flag identifies all compounds identified in an analysis at a secondary dilution factor.

****************************** ANALYTICAL LABORATORY GROUP - DATA REPORTING SHEET (PAGE 1 OF 5) ************************

JOB DESCRIPTION: BALDWIN - R. PRICE JOB NUMBER: CQEED3830CE000H RECEIPT DATE: 17
CHEM. PRESERVATIVE: TYPE OF SAMPLE: SEDIMENT EST. COMP. DATE: 21

COLUMN.......... 1
ANALYTE......... 8
MG/KG........... HG

SAMP #	DESCRIPTION		
11947	PSC2-WT-R1	CONC	0.107
		%REC	114.0
		DUPL	<0.100
		OID	56651189
11948	PSC2-WT-R2	CONC	<0.100
		%REC	
		DUPL	<0.100
		OID	56651189
11949	PSC2-WT-R3	CONC	<0.100
		%REC	
		DUPL	0.213
		OID	56651189
11950	PSC2-WT-R4	CONC	<0.100
		%REC	
		DUPL	0.144
		OID	56651189
11951	PSC3-WT-R1	CONC	0.324
		%REC	
		DUPL	0.290
		OID	56651189
11952	PSC3-WT-R2	CONC	0.399
		%REC	
		DUPL	0.374
		OID	56651189

HG Mercury

JOB DESCRIPTION: BALDWIN - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: CQEED3830CE000H
TYPE OF SAMPLE: SEDIMENT

RECEIPT DATE:
EST. COMP. DATE: 2

COLUMN......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
11953	PSC3-WT-R3	CONC	0.498
		%REC	
		DUPL	0.376
		OID	56651189
11954	PSC3-WT-R4	CONC	0.372
		%REC	
		DUPL	0.415
		OID	56651189
11955	PSC4-AD-R1	CONC	0.291
		%REC	
		DUPL	0.247
		OID	56651189
11956	PSC4-AD-R2	CONC	0.245
		%REC	
		DUPL	0.245
		OID	56651189
11957	PSC4-AD-R3	CONC	0.218
		%REC	108.0
		DUPL	0.218
		OID	56651189
11958	PSC4-AD-R4	CONC	0.251
		%REC	
		DUPL	0.255
		OID	56651189

HG Mercury

JOB DESCRIPTION: BALDWIN - R. PRICE JOB NUMBER: CQEED3830CE000H RECEIPT DATE: 17
CHEM. PRESERVATIVE: TYPE OF SAMPLE: SEDIMENT EST. COMP. DATE: 21

COLUMN.......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
11959	PSC4-ADW-R1	CONC	0.287
		%REC	
		DUPL	0.323
		OID	56651189
11960	PSC4-ADW-R2	CONC	0.256
		%REC	
		DUPL	0.287
		OID	56651189
11961	PSC4-ADW-R3	CONC	0.293
		%REC	
		DUPL	0.287
		OID	56651189
11962	PSC4-ADW-R4	CONC	0.198
		%REC	
		DUPL	0.158
		OID	56651189
11963	WRC1-AD-R1	CONC	0.121
		%REC	
		DUPL	0.158
		OID	56651189
11964	WRC1-AD-R2	CONC	0.119
		%REC	
		DUPL	0.201
		OID	56651189

HG Mercury

JOB DESCRIPTION: BALDWIN - R. PRICE
CHEM. PRESERVATIVE:

JOB NUMBER: CQEED3830CE000H
TYPE OF SAMPLE: SEDIMENT

RECEIPT DATE: 17
EST. COMP. DATE: 21

COLUMN......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
11965	WRC1-AD-R3	CONC	0.161
		%REC	111.0
		DUPL	0.119
		OID	56651189
11966	WRC1-AD-R4	CONC	0.158
		%REC	
		DUPL	0.119
		OID	56651189
11967	WRC1-ADW-R1	CONC	0.374
		%REC	95.0
		DUPL	0.329
		OID	56651189
11968	WRC1-ADW-R2	CONC	0.111
		%REC	
		DUPL	0.111
		OID	56651189
11969	WRC1-ADW-R3	CONC	0.219
		%REC	
		DUPL	0.110
		OID	56651189
11970	WRC1-ADW-R4	CONC	0.112
		%REC	
		DUPL	0.151
		OID	56651189

HG Mercury

JOB DESCRIPTION: BALDWIN - R. PRICE JOB NUMBER: CQEED3830CE000H RECEIPT DATE: 17
CHEM. PRESERVATIVE: TYPE OF SAMPLE: SEDIMENT EST. COMP. DATE: 21

COLUMN......... 1
ANALYTE........ 8
MG/KG.......... HG

SAMP #	DESCRIPTION		
11971	WRS-AD-R1	CONC	0.112
		%REC	
		DUPL	0.112
		OID	56651189
11972	WRS-AD-R2	CONC	<0.100
		%REC	
		DUPL	<0.100
		OID	56651189
11973	WRS-AD-R3	CONC	<0.100
		%REC	
		DUPL	<0.100
		OID	56651189
11974	WRS-AD-R4	CONC	<0.100
		%REC	
		DUPL	<0.100
		OID	56651189

HG Mercury

327pah.SEDdata

10/28/91
WES BALDWIN (CF#327)
PAH CONCENTRATIONS
IN SEDIMENT DATA
(concentrations in ug/kg dry weight)

Client ID	Sponsor Code	Sample ID	Naph-thalene	Acenaph-thylene	Acenaph-thene	Flourene	Phenan-threne	Anthra-cene	Flouran-thene	Pyrene	Benzo(a)-Anthracene
327-1	PB-PSC2-WT-R1	249259	5.2 U	5.2 U	5.2 U	5.2 U	6.1	5.2 U	7.9	9.3	5.2 U
327-2	PB-PSC2-WT-R2	249260	6.4 B	5.9 U	5.9 U	5.9 U	7.5	5.9 U	7.4	9.3	5.9 U
327-3	PB-PSC2-WT-R3	249261	5.5 U	5.5 U	5.5 U	5.5 U	7.2	5.5 U	8.1	10.2	5.5 U
327-4	PB-PSC2-WT-R4	249262	6.7 B	5.3 U	5.3 U	5.3 U	8.7	5.3 U	12.7	17.4	5.3 U
327-5	PB-PSC3-WT-R1	249263	5.6 U	5.6 U	5.6 U	5.6 U	11.6	5.6 U	30.2	40.7	12.7
327-6	PB-PSC3-WT-R2	249264	6.8 B	5.8 U	5.8 U	5.8 U	9.4	5.8 U	17.2	23.1	7.8
327-7	PB-PSC3-WT-R3	249265	7.4 B	5.5 U	5.5 U	5.5 U	8.3	5.5 U	13.8	18.2	6.0
327-8	PB-PSC3-WT-R4	249266	5.4 U	5.4 U	5.4 U	5.4 U	6.0	5.4 U	20.4	23.9	13.8
327-9	PB-PSC4-AD-R1	249267	4.5 B	3.7 U	3.7 U	3.7 U	8.2	3.7 U	17.4	18.9	8.5
327-10	PB-PSC4-AD-R2	249268	6.3 B	4.0 U	4.0 U	4.0 U	7.9	4.0 U	17.7	20.6	9.3
327-11	PB-PSC4-AD-R3	249269	6.6 B	3.9 U	3.9 U	3.9 U	5.7	3.9 U	13.4	16.5	5.9
327-12	PB-PSC4-AD-R4	249270	15.6 B	3.9 U	3.9 U	3.9 U	6.5	3.9 U	13.7	16.8	5.9
327-13	PB-PSC4-ADW-R1	249271	7.8 B	3.8 U	3.8 U	3.8 U	9.0	3.8 U	19.9	26.2	9.1
327-14	PB-PSC4-ADW-R2	249272	7.2 B	3.8 U	3.8 U	3.8 U	7.6	3.8 U	14.7	15.8	6.7
327-15	PB-PSC4-ADW-R3	249273	8.4 B	4.0 U	4.0 U	4.0 U	7.5	4.0 U	14.7	15.5	6.0
327-16	PB-PSC4-ADW-R4	249274	6.6 B	4.0 U	4.0 U	4.0 U	7.8	4.0 U	15.3	16.2	6.4
327-17 DL	PB-WRC1-AD-R1	249275 1:10 DIL	39.2 U	73.7 D	39.2 U	39.2 U	390.6 D	112.7 D	690.2 D	849.5 D	376.6 D
327-18 DL	PB-WRC1-AD-R2	249276 1:10 DIL	38.5 U	69.9 D	38.5 U	38.5 U	473.9 D	104.1 D	678.5 D	850.7 D	331.0 D
327-19 DL	PB-WRC1-AD-R3	249277 1:10 DIL	39.0 U	44.5 D	39.0 U	39.0 U	314.3 D	78.3 D	441.7 D	563.6 D	195.9 D
327-20 DL	PB-WRC1-AC-R4	249278 1:10 DIL	40.0 U	125.3 D	62.7 D	87.8 D	933.6 D	284.5 D	977.4 D	1243.0 D	554.0 D
327-21 DL	PB-WRC1-ADW-R1	249279 1:10 DIL	39.2 U	50.2 D	39.2 U	39.2 U	436.8 D	114.9 D	652.0 D	789.0 D	326.6 D
327-22 DL	PB-WRC1-ADW-R2	249280 1:10 DIL	36.4 U	36.4 U	36.4 U	36.4 U	225.6 D	50.2 D	418.7 D	522.9 D	207.6 D
327-23 DL	PB-WRC1-ADW-R3	249281 1:10 DIL	40.0 U	44.2 D	40.0 U	40.0 U	353.7 D	114.6 D	660.4 D	817.2 D	354.3 D
327-24 DL	PB-WRC1-ADW-R4	249282 1:10 DIL	39.2 U	45.8 D	39.2 U	39.2 U	385.9 D	122.2 D	582.7 D	738.0 D	330.4 D
327-25	PB-WRS-AD-R1	249283	9.6 B	3.8 U	3.8 U	3.8 U	5.0	3.8 U	3.8 U	3.8 U	3.8 U
327-26	PB-WRS-AD-R2	249284	20.1 B	3.8 U	3.8 U	5.5	66.2	3.8 U	58.1	39.5	9.1
327-27	PB-WRS-AD-R3	249285	8.4 B	3.8 U	3.8 U	5.7	34.9	3.8 U	25.7	17.3	4.3
327-28	PB-WRS-AD-R4	249286	9.3 B	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U

WES BALDWIN (CF #346)

TISSUE METAL RESULTS

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP-MS	Pb ICP-MS
346-1 REP 1	PSUPCOMP	24.2	13.1	23.9	140.7	17.1	4.6	0.062	3.460	0.102	1.780
346-1 REP 2	PSUPCOMP	NA	NA	NA	NA	NA	NA	0.065	3.650	0.113	2.020
346-2	WRUPCOMP	59.7	21.1	18.3	97.8	16.37	4.09	0.057	2.940	0.181	2.180
346-3	WRSFCOMP	4.9 U	1.97	8.03	41.8	0.56 U	0.6 U	0.068	0.061	0.02	0.158
346-4 REP 1	PS2SFCOMP	6.1 U	1.48	7.72	32.8	0.98	0.61 U	0.083	0.106	0.013	0.341
346-4 REP 2	PS2SFCOMP	6.2 U	1.2 U	8.68	33.2	0.7 U	0.57 U	0.086	0.126	0.014	0.410
346-5	PS3SFCOMP	4.7 U	1.5	7.11	31.8	0.66 U	0.54 U	0.054	0.063	0.011	0.256
346-6	PS3R2SF	5.1 U	1.99	7.55	38.6	0.66 U	0.54 U	0.061	0.057	0.01	0.190
346-7	WRSSCOMP	11 U	2.3 U	8.7	17.6	0.76 U	0.77 U	0.016	0.044	0.038	0.338
346-8	WRR1SS	9.4 U	1.96	10.13	13.42	0.68 U	0.7 U	0.023	0.039	0.032	0.103
346-9	PS2SSCOMP	10 U	1.9 U	7.71	14.6	0.91 U	0.73 U	0.019	0.055	0.033	0.142
346-10	PS3SSCOMP	10 U	2.8	11.2	19.5	0.93 U	0.77 U	0.028	0.077	0.03	0.208
346-11	WRDSSCOMP	12 U	2.1 U	6.94	10.48	0.98 U	0.8 U	0.008	0.028	0.021	0.058
346-12	WRDR2SS	8.4 U	2.1	10.1	13.12	0.83 U	0.71 U	0.016	0.042	0.037	0.083
346-13	WRR1SSE	8.2 U	1.7 U	5.67	12.99	0.62 U	0.69 U	0.026	0.036	0.037	0.150
346-14	WRR2SSE	8.3 U	1.5 U	6.79	17.9	0.88 U	0.69 U	0.019	0.029	0.023	0.168
346-15	PS2R1SSE	9.3 U	1.9 U	8.69	19.4	0.73 U	0.74 U	0.019	0.096	0.033	0.200
346-16	PS2R2SSE	7.5 U	1.6 U	9.58	18.9	0.84 U	0.68 U	0.023	0.046	0.023	0.158
346-17	PS3R1SSE	8 U	1.72	8.56	15.9	0.82 U	0.67 U	0.019	0.057	0.029	0.167
346-18	PS3R2SSE	8.4 U	1.6 U	9.2	18.6	0.84	0.67 U	0.023	0.038	0.021	0.229
346-19	PS3R3SSE	13.1	1.7 U	11.3	29.1	0.86 U	0.68 U	0.031	0.077	0.028	0.583
Blank REP 1		NA	NA	NA	NA	NA	NA	0.003	0.0019	0.009	0.008
Blank REP 2		NA	NA	NA	NA	NA	NA	0.002	0.0014		0.004

NA - Not applicable.
U - Indicates analyte not detected above detection limits.

WES BALDWIN (CF #346)

TISSUE METAL RESULTS

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP-MS	Pb ICP-MS
STANDARD REFERENCE MATERIAL											
1566A REP 1		4 U	2.61	68.4	835	14.15	2	1.43	3.71	0.043	0.276
1566A REP 2		4.1 U	3.03	67.1	842	14.06	2.25	NA	NA	0.06	NA
1566A REP 3		3.9 U	3.12	65.5	840	14.31	1.94	NA	NA		NA
	certified	1.43	2.25	66.3	830	14	2.21	1.68	4.15	0.064	0.371
	value	±0.46	±0.44	±4.3	±57	±1.2	±0.24	±0.15	±0.38	±0.0067	±0.014
1571 O.L.		5.0 U	1.32	13.58	44.1	12.17	0.48	0.017	0.102	0.109	42.3
	certified	NC	1.3	12	25	14	0.08	NC	0.11	0.155	45
	value	NC	±0.2	±1	±3	±2	±0.01	NC	±0.02	±0.015	±3

U = Indicates analyte not detected above detection limits.
NA = Not applicable.
NC = Indicates not certified.

WES BALDWIN (CF #346)

TISSUE METAL RESULTS

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP-MS	Pb ICP-MS
MATRIX SPIKE RESULTS											
Amount Spiked		NA	NA	NA	NA	NA	NA	1	0.5	2	5
346-2	WRUPCOMP	NA	NA	NA	NA	NA	NA	0.057	2.94	0.181	2.16
346-2+Spike		NA	NA	NA	NA	NA	NA	1.7	7.7	1.44	10.9
Amount Recovered		NA	NA	NA	NA	NA	NA	1.6	4.8	1.3	8.7
Percent Recovery		NA	NA	NA	NA	NA	NA	164%	952%	63%	175%
Amount Spiked		NA	NA	NA	NA	NA	NA	1	0.5	0.5	5
346-6	PS3R2SF	NA	NA	NA	NA	NA	NA	0.061	0.057	0.01	0.19
346-6+Spike		NA	NA	NA	NA	NA	NA	0.865	0.478	0.274	4.3
Amount Recovered		NA	NA	NA	NA	NA	NA	0.8	0.4	0.3	4.1
Percent Recovery		NA	NA	NA	NA	NA	NA	80%	84%	53%	82%

NA = Not applicable.

WES BALDWIN (CF #346) 11/14/91

PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	Blank	PSUPCOMP	WRUPCOMP	PS2SFCOMP	WRR1SS	PS2SSCOMP	PS3SSCOMP	WRDR2SS	WRR1SSE
Sample ID	JM23PB *	346-01	346-02	346-04	346-08	346-09	346-10	346-12	346-13
Species	NA	Worm	Worm	PLANT	Plant	PLANT	PLANT	Plant	Plant
Wet Weight(g)	1.000	12.252	3.340	5.785	15.410	6.299	6.274	7.674	18.731
A-BHC	7.551 C	0.173 JC	0.743 U	0.429 U	0.161 U	0.516 C	0.395 U	0.323 U	0.132 U
B-BHC	69.482 C	10.356 B	0.743 U	0.429 U	0.161 U	0.394 U	0.395 U	0.323 U	0.132 U
LINDANE	32.099 C	6.116	3.411	5.092	0.654	5.614	6.381	1.301	0.665
D-BHC	65.957 C	0.637	2.946 C	0.429 U	0.161 U	0.394 U	0.395 U	0.323 U	0.132 U
HEPTACHLOR	14.222 C	0.978	1.519 U	0.877 U	0.329 U	0.805 U	0.809 U	0.661 U	0.271 U
ALDRIN	45.27 C	3.407	3.025	1.001	0.542	0.897	0.752 C	0.664	0.65 C
HEPTACHLOREPOXIDE	66.447 C	0.227 U	0.832 U	0.48 U	0.536	0.384 JC	0.272 JC	0.362 U	0.291 C
A-ENDOSULFAN	7.109 U	0.58 U	2.366 C	0.415	0.704	0.705	0.898	1.174	0.756
DIELDRIN	42.782 C	0.66	1.59	4.472 U	0.082 JC	4.107 U	4.123 U	3.371 U	0.584 JC
PPDDE	17.749 C	1.038 C	1.718 C	0.584 U	1.238 C	0.537 U	0.539 U	1.065 C	0.729 C
ENDRIN	24.397 U	1.991 U	7.304 U	4.217 U	1.583 U	3.873 U	3.889 U	3.179 U	0.215 J
B-ENDOSULFAN	0.494 J	0.58 U	2.128 U	1.229 U	0.119 J	0.231	1.133 U	0.926 U	0.153 J
PPDDD	12.181	0.136 U	0.5 U	0.598	0.348	0.265 U	0.266 U	0.218 U	0.195 C
ENDRIN ALDEHYDE	7.109 U	0.58 U	2.128 U	1.229 U	0.461 U	1.129 U	1.133 U	0.926 U	0.38 U
ENDOSULFAN SULFATE	7.109 U	3.078	2.128 U	2.179	0.461 U	1.129 U	1.133 U	0.926 U	0.38 U
PPDDT	5.215 U	0.16	1.769	0.901 U	0.338 U	0.828 U	0.831 U	0.68 U	0.661 C
TOXAPHENE	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
CHLORDANE	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
Aroclor 1242	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
Aroclor 1248	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
Aroclor 1254	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
Aroclor 1260	71.089 U	5.802 U	21.284 U	12.289 U	4.613 U	11.286 U	11.331 U	9.264 U	3.795 U
DBOFB (% Rec)	90	58	78	118	113	105	107	104	106
TCN (% Rec)	104 &	59	78	81	93	73	112	89	87

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
U - Not detected at detection limit shown
B - Value corrected for method blank contamination
NS - Not spiked
& - Surrogate Recovery out of range

WES BALDWIN (CF #346)

PCB/PESTICIDE RESULTS IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	WRR2SSE	PS2R1SSE	PS2R2SSE	PS3R1SSE	PS3R2SSE	PS3R3SSE	Matrix Spike	Matrix Spike
Sample ID	346-14	346-15	346-16	346-17	346-18	346-19	346-15	% Recovery
Species	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT	
Wet Weight(g)	15.878	21.150	30.217	30.425	30.439	5.657	20.219	
A-BHC	0.156 U	0.117 U	0.155 C	0.082 U	0.081 U	0.438 U	2.258 C	57 C
B-BHC	0.156 U	0.117 U	2.531 C	0.082 U	0.081 U	0.438 U	3.414 C	86 C
LINDANE	4.89	0.503	1.099	0.703	0.691	5.836	2.854	59 *
D-BHC	0.156 U	0.117 U	0.082 U	0.082 U	0.081 U	0.438 U	2.867 C	72 C
HEPTACHLOR	0.319 U	0.24 U	0.168 U	0.167 U	0.167 U	0.897 U	3.106 C	79 C
ALDRIN	0.375	0.442 C	0.08 U	0.08 U	0.232 C	0.754	2.536 C	53 C
HEPTACHLOREPOXIDE	0.176 C	0.131 U	0.092 U	0.091 U	0.091 U	0.491 U	2.965 C	75 C
A-ENDOSULFAN	0.419	0.762	0.682	0.552	0.512	0.877	4.645 C	98 C
DIELDRIN	0.128	1.223 U	0.118 J	0.85 U	0.137 J	4.573 U	3.169 C	80 C
PPDDE	0.213 U	0.889 C	0.674 C	0.636 C	0.492 C	0.894	4.737 C	97 C
ENDRIN	1.537 U	1.154 U	0.807 U	0.802 U	0.802 U	4.313 U	2.944 C	74 C
B-ENDOSULFAN	0.448 U	0.336 U	0.235 U	0.234 U	0.234 U	0.222	7.05 C	178 C
PPDDD	0.105 U	0.079 U	0.055 U	0.055 U	0.055 U	0.184 JC	3.059 C	0 ND
ENDRIN ALDEHYDE	0.448 U	0.336 U	0.235 U	0.234 U	0.234 U	1.257 U	0.352 U	117 C
ENDOSULFAN SULFATE	0.448 U	0.336 U	0.235 U	0.257	0.234 U	1.257 U	4.617 C	66 C
PPDDT	0.328 U	0.247 U	0.173 U	0.171 U	0.171 U	0.922 U	2.596 C	NS
TOXAPHENE	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	3.516 U	NS
CHLORDANE	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	3.516 U	NS
Aroclor 1242	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	3.516 U	NS
Aroclor 1248	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	3.516 U	NS
Aroclor 1254	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	777.581 C	79 C
Aroclor 1260	4.477 U	3.361 U	2.353 U	2.337 U	2.335 U	12.567 U	3.516 U	NS
DBOFB (% Rec)	105	97	68	111	102	108		
TCN (% Rec)	67	69	67	79	68	83		120 134 &

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
U - Not detected at detection limit shown
B - Value corrected for method blank contamination
NS - Not spiked
& - Surrogate Recovery out of range

WES-BALDWIN (CF #346) 11/14/91

PAH RESULTS IN PLANTS

(Concentrations in ug/kg (ppb) WET Wt.)

Sponsor Code:	Method Blank	Method Blank *	PSUPCOMP	WRUPCOMP	PS2SFCOMP	WRR1SS	PS2SSCCOMP	PS3SSCOMP
Sample Number	JM23PB	JM39PB	346-01	346-02	346-04	346-08	346-09	346-10
Species	NA	NA	PLANT	PLANT	PLANT	Plant	PLANT	PLANT
Wet Weight(g)	1.000	1.000	12.252	3.340	5.785	15.410	6.299	6.274
naphthalene	192.79	170.88	3.34 U	2.2 JB	7.07 U	2.66 U	6.5 U	6.52 U
acenaphthylene	11.37 J	40.14 U	3.28 U	3.51 J	6.94 U	1.41 J	6.37 U	6.4 U
acenaphthene	22.6	9.81 J	1.77 U	3.08 J	3.75 U	1.46	0.99 J	3.46 U
fluorene	10.04 J	8.91 J	1.09 J	3.25 J	0.93 J	0.92 J	1.24 J	1.07 J
phenanthrene	18.17 J	24.67	3.25	24.22	3.53	3.16	3.19	3.73
anthracene	17.77 U	17.77 U	1.75	5.91	0.42 J	0.28 J	0.27 J	2.83 U
fluoranthene	1.65 J	1.69 J	4.91	47.81	3.04	1.94	1.83 J	1.87 J
pyrene	2.27 J	1.2 J	16.91	92.06	3.29 J	1.65	1.7 J	1.65 J
benz[a]anthracene	29.68 U	29.68 U	5.72	28.11	0.6 J	0.27 J	0.38 J	0.51 J
chrysene	20.8 U	20.8 U	11.11	39.98	1.2 J	0.57 J	0.7 J	0.78 J
benzo[b]fluoranthene	30.29 U	30.29 U	4.19	73.23	5.24 U	1.97 U	4.81 U	4.83 U
benzo[k]fluoranthene	25.37 U	25.37 U	5.43	61.46	4.39 U	1.65 U	4.03 U	4.04 U
benzo[a]pyrene	26.42 U	26.42 U	3.77 M	88.02 M	4.57 U	1.71 U	4.19 U	4.21 U
indeno[1,2,3-c,d]pyrene	31.67 U	31.67 U	2.59 U	9.48 U	5.48 U	2.06 U	5.03 U	5.05 U
dibenz[a,h]anthracene	21.54 U	21.54 U	1.76 U	6.45 U	3.72 U	1.4 U	3.42 U	3.43 U
benzo[g,h,i]perylene	42.95 U	42.95 U	3.51 U	12.86 U	7.42 U	2.79 U	6.82 U	6.85 U
Surrogate % Recoveries:								
naphthalene-d8 (% Rec)	65	74	75	77	45	66	74	78
acenaphthene-d10 (% Rec)	80 M	85 M	85 M	101 M	61 M	106 M	94 M	98 M
benzo[a]pyrene-d12 (% Rec)	71	61	68	86	60	88	82	86

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference
B - Value corrected for Blank contamination
& - Surrogate Recovery out of range

WES-BALDWIN (CF #346) 11/14/91
BUTYLTIN RESULTS IN PLANTS

(Concentrations in ug/kg (ppb) WET Wt.)

Sponsor Code	PSUPCOMP	PS2SFCOMP	WRR1SS	WRR1SSE	PS2R1SSE	PS2R2SSE	PS3R1SSE
Sample ID	346-1	346-4	346-8	346-13	346-15	346-16	346-17
Wet Weight (g)	2.2	1.512	1.72	2.762	3.01	4.14	2.483
Percent Dry Weight	NA	NA	NA	NA	NA	NA	NA
Dry Weight (g)	NA	NA	NA	NA	NA	NA	NA
TBT	9.0 J	38.3 U	38.3 U	38.3 U	38.3 U	38.3 U	38.3 U
DBT	18.1 U	18.1 U	18.1 U	6.9 J	18.1 U	18.1 U	18.1 U
MBT	3.1 J	7.7 J	8.0 J	9.7 J	4.3 J	12.1	10.2 J
TPT %Recovery	77.8	53.9	56.8	47.8	39.7	62.8	51.2

U - Not detected, reported as MDL
J - Value below MDL
& - Surrogate Recovery out of range

WES-BALDWIN (CF #346)
BUTYLTIN RESULTS IN PLANTS

(Concentrations in ug/kg (ppb) WET Wt.)

Sponsor Code	PS3R2SSE	WRR2SSE	WRR2SSE	Procedural	Matrix	
Sample ID	346-18	346-14	346-14dup	Blank	Spike	
Wet Weight (g)	3.05	2.06	2.52	1	2.35	Matrix
Percent Dry Weight	NA	NA	NA	NA	40.60	Spike
Dry Weight (g)	NA	NA	NA	NA	0.954	% Recovery
TBT	38.3 U	38.3 U	38.3 U	38.3 U	237.3	169.4 &
DBT	18.1 U	18.1 U	18.1 U	18.1 U	216.4	187.9
MBT	11.7	16.4 U	13.5 J	38.4	63.4	59.9
TPT %Recovery	36.4	57.1	44.3	45.5	52.7	

U - Not detected, reported as MDL
J - Value below MDL
& - Surrogate Recovery out of range

347METALS.DATA

METALS CONCENTRATIONS IN PLANTS 10/30/91

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
WORMS												
347-1	BRHCOMP	124.3	12.2	168.2	166.7	6.07	4.66	3.400	7.260	0.765	32.1	22.8
347-2	BRHWMCOMP	83.1	7.46	190.5	150	8.27	4.96	3.100	5.050	0.445	17.5	13.5
347-3 REP 1	OAIUPCOMP	79.4	11.57	19.2	107.1	11.83	3.34	0.102	3.580	0.780	2.62	1.64
347-3 REP 2	OAIUPCOMP	67.5	10.42	20.4	112.1	12.41	3.61	0.099	3.650	0.078	2.46	1.63
347-4	OAOUPCOMP	33.1	8.97	17.2	93.8	11.51	3.74	0.106	3.930	0.078	3.47	2.11
347-39	MANR1	3.2 U	1.85	22.7	175	4.51	3.13	0.032	5.390	0.044	2.3 U	0.872
347-40	MANR2	3.6 U	2.3	24.8	177.1	4.58	3.07	0.023	5.120	0.044	2.4 U	0.842
347-41	MANR3	3.7 U	1.08	23.5	162.9	4.91	3.41	0.005	1.900	0.011	2.1 U	0.226
347-42	MANR4	3.8	2.28	24.1	183.7	4.54	3.39	0.036	6.330	0.041	2.1 U	0.849
PLANTS												
347-5	OAP3SFCOMP	6.2 U	1.81	6.19	34.1	0.61 U	0.45 U	0.146	0.093	0.016	1.49	0.346
347-6 REP 1	OAP3R3SF	6.7	1.10 U	4.89	4.89	0.57 U	0.47	0.080	0.027	0.007	1.5 U	0.095
347-6 REP 2	OAP3R3SF	5.7 U	1.10 U	4.28	4.28	0.45 U	0.48 U	0.081	0.035	0.006	1.6 U	0.094
347-7	OISFCOMP	4.6 U	1.73	6.47	40.4	0.92 U	0.71 U	0.123	0.103	0.012	2.3 U	0.182
347-8	OOGFCOMP	4.0 U	0.85	6.86	108.9	0.97 U	0.72 U	0.100	0.073	0.006	2.5 U	0.259
347-9	OORCSF	5.9	0.97	7.44	29.2	0.91 U	0.67 U	0.156	0.115	0.023	2.2 U	0.535
347-10	BRHR1SA	12.0	1.68	19.2	52	0.64 U	0.67 U	0.120	0.220	0.025	2.2 U	1.37
347-11	BRHR2SA	5.1	2.72	14.2	53.8	0.98 U	0.74 U	0.089	0.205	0.021	2.5	0.747
347-12	BRHR3SA	4.6 U	2.59	17	51.6	0.94 U	0.72 U	0.144	0.274	0.019	2.3 U	1.14
347-13	OAP3SSCOMP	9.4 U	1.70 U	6.77	20.4	0.96 U	0.96 U	0.012	0.051	0.043	2.9 U	0.247
347-14	OAP3R1SS	7.6 U	1.74	7.7	11.5	0.95 U	1.0 U	0.016	0.027	0.034	3.1 U	0.245
347-15	OIR1SS	10.5	2.07	9.94	20.7	1.3 U	0.94 U	0.020	0.069	0.050	2.9 U	0.394
347-16	OISSCOMP	8.7 U	1.60 U	9.82	20.9	1.3 U	0.93 U	0.012	0.040	0.043	3.2	0.238
347-17	OOGSCOMP	7.8 U	1.55	11	23.5	1.3 U	1.0 U	0.013	0.402	0.049	3.1 U	0.542
347-18	BRHR1SS	8.4 U	1.92	14.6	19.9	0.91 U	0.71 U	0.072	0.277	0.086	3.2	2.25
347-19	BRHR2SS	8.5 U	1.50 U	11.7	15.1	0.6 U	0.62 U	0.053	0.110	0.050	1.9 U	0.994
347-20	BRHR3SS	7.6	1.50 U	21.3	23.5	0.84 U	0.61 U	0.121	0.354	0.049	3.1	3.62
347-21	MRGFCOMP	4.3 U	1.00 U	5.24	29.1	0.47 U	0.5 U	0.095	0.121	0.020	1.6 U	0.199
347-22 REP 1	MRR3SF	5.1 U	1.00 U	4.96	18.3	0.62 U	0.49 U	0.100	0.089	0.016	1.6 U	0.232
347-22 REP 2	MRR3SF	4.7 U	0.10 U	4.79	19.6	0.69 U	0.55 U	0.109	0.098	0.015	1.8 U	0.266
347-23	MRR1SS	9.2 U	3.16	11	24.1	0.86 U	0.69 U	0.008	0.149	0.038	2.2 U	0.318
347-24	MRR2SS	7.8 U	2.80	8.12	24.8	0.72 U	0.61 U	0.012	0.081	0.052	1.8 U	0.155
347-25	SASSCOMP	9.4 U	3.38	14.8	27.3	0.93 U	0.74 U	0.065	0.198	0.064	2.3 U	0.677
347-26	OAP3R1SSE	8.1 U	1.70 U	10.79	13.69	0.84 U	0.7 U	0.020	0.037	0.058	2.1 U	0.388
347-27	OAP3R2SSE	7.5 U	1.60 U	8.32	16.2	0.92 U	0.71 U	0.037	0.079	0.052	2.3 U	0.642

U - Indicates analyte not detected above detection limits.

METALS CONCENTRATIONS IN PLANTS 10/30/91

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
347-28	OAP3R3SSE	8.7 U	2.46	9.4	17.4	0.87 U	0.65 U	0.016	0.063	0.051	2.2 U	0.584
347-29	OIR1SSE	8.2 U	1.60 U	7.91	17.1	0.83 U	0.66 U	0.015	0.046	0.063	2.1 U	0.288
347-30	OISSCOMPE	6.5 U	2.46	9.56	27.5	1.2 U	0.91 U	0.029	0.093	0.047	2.9 U	0.468
347-31	OOR1SSE	6.1 U	1.10 U	6.28	13.34	1.2 U	0.9 U	0.013	0.072	0.063	3.0 U	0.298
347-32	OOR2SSE	5.8 U	1.68	11.08	21.2	1.2 U	0.9 U	0.026	0.091	0.042	2.9 U	0.515
347-33	SAR1SSE	5.1 U	1.24	8.1	21	1.2 U	0.88 U	0.028	0.069	0.065	2.9 U	0.261
347-34	SAR2SSE	5.9 U	1.2 U	9.08	18.8	1.2 U	0.94 U	0.020	0.055	0.056	3.0 U	0.318
347-35	SAR3SSE	7.0 U	1.5 U	7.68	16.7	1.4 U	1.0 U	0.015	0.103	0.049	3.4 U	0.473
347-36	ERR1SS	6.4 U	1.3 U	6.88	18.7	1.2 U	0.94 U	0.036	0.033	0.058	3.0 U	0.173
347-37	ERR2SS	6.4 U	2.06	5.71	14.6	0.83 U	0.86 U	0.035	0.062	0.069	2.8 U	0.402
347-38	ERR3SS	6.6 U	1.3 U	11.9	27.1	0.95 U	0.96 U	0.026	0.074	0.048	3.1 U	0.388
PROCEDURAL BLANKS												
Blank REP 1		NA	NA	NA	NA	NA	NA	1.40	1.17	0.007	NA	0.93
Blank REP 2		NA	NA	NA	NA	NA	NA	1.86	1.17	0.009	NA	1.4

NA - Not applicable.
U - Indicates analyte not detected above detection limits.

STANDARD REFERENCE MATERIAL

Sample Number		Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
1566A-1		NA	NA	NA	NA	NA	NA	1.49	3.9	0.06	NA	0.355
1566A-2		3.8 U	2.49	65.8	850	14.86	2.33	1.48	3.75	0.059	1.4 U	0.379
	certified	1.43	2.25	66.3	830	14	2.21	1.68	4.15	0.064	0.37	0.371
	value	±0.46	±0.44	±4.3	±57	±1.2	±0.24	±0.15	±0.38	±0.0067	±0.014	±0.014
1571-1 REP 1		3.8 U	1.27	13.98	28.5	10.84	0.55 U	0.02	0.112	0.109	41.5	41.8
1571-1 REP 2		4.6	1.38	13.1	25.9	9.86	0.57 U	NA	NA		42.2	NA
1571-2 REP1		4.7 U	1.47	13.27	28.7	8.05	0.41 U	0.02	0.108	0.108	44.0	41.5
1571-2 REP 2		4.3 U	1.32	14.01	25.4	9.1	0.43 U	NA	NA		43.1	NA
	certified	NC	1.3	12	25	14	0.08	NC	0.11	0.155	45	45
	value	NC	±0.2	±1	±3	±2	±0.01	NC	±0.02	±0.015	±3	±3

NA - Not applicable.
U - Indicates analyte not detected above detection limits.
NC - Not certified.

PAH CONCENTRATIONS IN
PLANT AND WORM TISSUE
(cl# 347)

(Concentrations in ug/kg wet wt)

Sponsor Code:	METHOD BLANK	BRHCOMP	BRHAMCOMP	OAIUPCOMP	OACUPCOMP	OAP3R3SF	COSFCOMP
Sample Number	JM39PB	347-01	347-02	347-03	347-04	347-06	347-08
Species	NA	EARTHWORM	EARTHWORM	EARTHWORM	EARTHWORM	PLANT	PLANT
Wet Weight(g)	10.000	6.513	2.474	4.069	7.987	4.188	1.903
naphthalene	17.088	2.73 JB	16.54 UB	4.49 JB	5.12 UB	26.24 B	21.5 UB
acenaphthylene	4.014 U	9.23	6.33 J	9.87 U	5.03 U	9.59 U	21.09 U
acenaphthene	0.981 J	3.33 U	8.76 U	3.74 J	1.46 J	3.22 J	11.39 U
fluorene	0.891 J	2.04 J	3.19 J	3.23 J	1.04 J	3.2 J	2.48 J
phenanthrene	2.467	24.25	19.66	16.86	4.75	6.2	5.95 J
anthracene	1.777 U	8.14	4.14 J	5.47	2.39	4.24 U	9.34 U
fluoranthene	0.169 J	32.48	25.25	38.07	12.26	3.17 J	2.75 J
pyrene	0.120 J	38.95	34.29	378.65	86.76	3.48 J	3.25 J
benz[a]anthracene	2.968 U	24.59	19.06	27.11	11.95	7.09 U	15.6 U
chrysene	2.080 U	183.54	132.87	57.42	22.52	1.19 J	1.35 J
benzo[b]fluoranthene	3.029 U	215.92	197.25	117.57	33.21	7.23 U	15.92 U
benzo[k]fluoranthene	2.537 U	139.62	90.2	95.5	25.08	6.06 U	13.33 U
benzo[a]pyrene	2.642 U	40.95 M	25.14 M	88.04 M	19.58 M	22.09 M	13.88 U
indeno[1,2,3-c,d]pyrene	3.167 U	4.86 U	12.8 U	7.78 U	3.97 U	7.56 U	16.64 U
dibenz[a,h]anthracene	2.154 U	1.78 J	8.71 U	5.29 U	2.7 U	5.14 U	11.32 U
benzo[g,h,i]perylene	4.295 U	6.6 U	12.67 J	10.59	5.38 U	10.26 U	22.57 U
naphthalene-d8 (% Rec)	73.65	80.29	60.49	66.63	54.28	63.74	61.24
acenaphthene-d10 (% Rec)	85.4 M	92.68 M	69.56 M	84.02 M	68.74 M	82.97 M	72.15 M
benzo[a]pyrene-d12 (% Rec)	61.34	80.29	43.85	63.62	45.52	76.03	68.74

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference

PAH CONCENTRATIONS IN PLANT AND WORM TISSUE (cl# 347)

(Concentrations In ug/kg wet wt)	
Sponsor Code:	MANR3
Sample Number	347-41
Species	EARTHWORM
Wet Weight(g)	8.306
naphthalene	4.93 UB
acenaphthylene	4.83 U
acenaphthene	1.33 J
fluorene	1.18 J
phenanthrene	3.2
anthracene	2.14 U
fluoranthene	0.48 J
pyrene	0.57 J
benz[a]anthracene	0.47 J
chrysene	0.88 J
benzo[b]fluoranthene	0.93 J
benzo[k]fluoranthene	0.78 J
benzo[a]pyrene	3.18 U
indeno[1,2,3-c,d]pyrene	3.81 U
dibenz[a,h]anthracene	2.59 U
benzo[g,h,i]perylene	5.17 U
naphthalene-d8 (% Rec)	64.75
acenaphthene-d10 (% Rec)	82.23 M
benzo[a]pyrene-d12 (% Rec)	72.53

* - Procedural Blank Reported In ng
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL In ng
M - Matrix Interference

WES BALDWIN (CF #347)

PCB/PESTICIDE RESULTS
IN TISSUE AND PLANT SAMPLES

(Concentrations In ug/kg (ppb) Wet Wt.)

Sponsor Code	SAR3SSE	ERR1SS	ERR2SS	ERR3SS	MANR3	Matrix Spike	Matrix Spike
Sample ID	347-35	347-36	347-37	347-38	347-41	347-11	% Recovery
Species	PLANT	PLANT	PLANT	PLANT	Worm	PLANT	
Wet Weight(g)	4.168	30.522	23.399	12.360	8.306	21.468	
A-BHC	0.441	0.081 U	0.106 U	0.201 U	0.304	3.823 C	103 C
B-BHC	0.595 UB	0.081 U	0.106 U	0.201 U	0.299 UB	1.115 B	30 B
LINDANE	3.887	0.966	0.558	2.011	0.299 U	9.178	76 *
D-BHC	0.595 U	0.081 U	0.106 U	0.201 U	0.299 U	2.447 C	66 C
HEPTACHLOR	1.217 U	0.166 U	0.217 U	0.41 U	0.611 U	4.092 C	110 C
ALDRIN	1.177	0.314	0.362	0.374	0.635	2.791 C	66 C
HEPTACHLOREPOXIDE	0.667 U	0.091 U	0.119 U	0.225 U	0.335 U	2.734 C	70 C
A-ENDOSULFAN	1.503 JC	0.645	0.465	0.535 J	0.954 C	1.956 C	45 C
DIELDRIN	0.426	0.848 U	0.139 J	0.121 J	3.114 U	4.941 C	133 C
PPDDE	1.66 C	1.244	0.743	0.615	0.562	3.433 C	92 C
ENDRIN	5.853 U	0.799 U	1.043 U	1.974 U	2.937 U	7.254 JC	195 C&
B-ENDOSULFAN	1.706 U	0.233 U	0.304 U	0.245 J	0.856 U	2.623 C	70 C
PPDDD	0.401 U	0.055 U	0.071 U	0.135 U	0.201 U	3.965 C	106 C
ENDRIN ALDEHYDE	1.706 U	0.233 U	0.304 U	0.575 U	0.856 U	0.331 U	0 ND
ENDOSULFAN SULFATE	1.706 U	0.233 U	0.304 U	0.575 U	0.856 U	0.892 C	24 C&
PPDDT	1.251 U	0.171 U	0.223 U	0.422 U	0.628 U	6.644 C	148 C
TOXAPHENE	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	3.311 U	
CHLORDANE	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	3.311 U	
Aroclor 1242	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	3.311 U	
Aroclor 1248	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	3.311 U	
Aroclor 1254	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	909.199 C	98 C
Aroclor 1260	17.056 U	2.329 U	3.038 U	5.752 U	8.559 U	3.311 U	
DBOFB (% Rec)	115	114	100	103	108		62
TCN (% Rec)	115	94	80	104	103		101

B - Blank corrected
ND - Non Detected * Procedural Blank Reported In ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #347) 11/14/91

PCB/PESTICIDE RESULTS
IN TISSUE AND PLANT SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	Blank	BRHCOMP	BRHAMCOMP	OAIUPCOMP	OAOUPCOMP	OAP3SFCOMP	OAP3RSF	OOSFCOMP	BRHR1SA
Sample ID	JM39PB *	347-01	347-02	347-03	347-04	347-05	347-06	347-08	347-10
Species	NA	Worm	Worm	Worm	Worm	PLANT	PLANT	PLANT	PLANT
Wet Weight(g)	1.000	6.513	2.474	4.069	7.987	3.730	4.188	1.903	20.672
A-BHC	4.394	0.381 U	1.002 U	0.609 U	0.311 U	0.665 U	15.01 C	1.303 U	0.217 C
B-BHC	23.984	0.381 U	1.002 U	0.609 U	0.311 U	0.665 U	0.592 U	1.303 U	0.12 U
LINDANE	2.48 U	4.358	1.002 U	6.514	0.311 U	1.287	28.291	7.147	0.721
D-BHC	2.48 U	0.381 U	1.002 U	5.939	0.311 U	0.665 U	0.592 U	1.303 U	0.12 U
HEPTACHLOR	5.073 U	14.403 C	2.051 U	1.247 U	0.635 U	1.36 U	18.091 C	2.666 U	0.245 U
ALDRIN	5.179	6.796	0.979 U	1.225	6.65 C	3.004 C	40.421 C	2.767	0.528 C
HEPTACHLOREPOXIDE	2.779 U	0.427 U	1.123 U	1.215 C	0.945 C	0.745 U	0.664 U	1.46 U	0.134 U
A-ENDOSULFAN	18.349 C	11.696	19.831	2.634	1.35 C	3.272	4.457 C	2.752 JC	0.351 C
DIELDRIN	25.868 U	17.959	9.948 JC	4.716 JC	12.866	6.935 U	32.654	13.593 U	1.251 U
PPDDE	3.38 U	18.193 C	43.687 C	30.301 C	21.859 C	0.906 U	8.698 C	1.776 U	0.238 C
ENDRIN	24.397 U	3.746 U	9.861 U	5.996 U	5.905 C	6.541 U	5.825 U	12.82 U	1.18 U
B-ENDOSULFAN	1.445	1.092 U	13.6 C	2.298	6.244 C	1.906 U	2.336 C	3.736 U	0.344 U
PPDDD	1.671 U	9.29 C	60.587 C	29.311 C	25.619 C	0.448 U	6.103 C	0.878 U	0.081 U
ENDRIN ALDEHYDE	7.109 U	1.092 U	2.873 U	1.747 U	0.89 U	1.906 U	1.697 U	3.736 U	0.344 U
ENDOSULFAN SULFATE	7.109 U	1.092 U	28.155	11.899	9.327 C	1.906 U	1.326	3.736 U	0.344 U
PPDDT	5.215 U	9.278 C	2.108 U	2.613	1.22	1.398 U	10.89	2.74 U	0.252 U
TOXAPHENE	71.089 U	10.915 U	28.734 U	17.471 U	8.901 U	19.059 U	16.974 U	37.356 U	3.439 U
CHLORDANE	71.089 U	10.915 U	28.734 U	17.471 U	8.901 U	19.059 U	16.974 U	37.356 U	3.439 U
Aroclor 1242	71.089 U	10.915 U	28.734 U	17.471 U	8.901 U	19.059 U	16.974 U	37.356 U	3.439 U
Aroclor 1248	71.089 U	10.915 U	28.734 U	17.471 U	8.901 U	19.059 U	16.974 U	37.356 U	3.439 U
Aroclor 1254	71.089 U	2026.302 C	3289.12 C	320.121 C	104.985 C	19.059 U	16.974 U	37.356 U	3.439 U
Aroclor 1260	71.089 U	10.915 U	28.734 U	17.471 U	8.901 U	19.059 U	16.974 U	37.356 U	3.439 U
DBOFB (% Rec)	83	121 &	65	68	69	100	70	99	114
TCN (% Rec)	88	207 &M	131 &	87	59	65	75	101	124 &

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng *
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

Appendix D
Plant and Animal Mesocosm Test

1. Metal Concentrations in Mussel Tissue
2. PCB/Pesticide Concentrations in Mussel Tissue
3. PAH Concentrations in Mussel Tissue
4. Organotin Analysis of Mussel Tissue
5. Metal Concentrations in Snail Tissue
6. Metal Concentrations in Plant Tissue
7. PAH Concentrations in Plant Tissue

APPENDIX D

Plant and Animal Mesocosm Test

1. Metal Concentrations in Mussel Tissue

Sediment	Sample Number	Sponsor Code
Marine Reference	364-43	MRR1
	364-44	MRR2
	364-36	MRR3
Sand Reference	364-47	SAR2
	364-53	SAR3
	364-59	SAR1
Blackrock Harbor	364-61	BRHR3
	364-62	BRHR1
Pinole Shoal	364-34	OAP3R2
	364-35	OAP3R1
	364-38	OAP3R3
	364-40	PS1R1
	364-41	PS3R2
	364-42	PS2R3
	364-45	PS3R3
	364-51	PS2R2
	364-58	PS3R1
West Richmond	364-46	WRDR3
	364-48	WRDR2
	364-49	WRR3
	364-50	WRR2
	364-52	WRDR1
	364-60	WRR1

WES - OAKLAND HARBOR (CF #364) 11/22/91

METALS CONCENTRATIONS
IN MUSSEL TISSUE SAMPLES

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP/MS	Cd ICP/MS	Hg CVAA	Pb XRF
364-34	OAP3R2MSM	7.3 U	1.2 U	16.30	56.7	10.90	1.86	0.73	1.51	0.145	1.5 U
364-35	OAP3R1MSM	7.9 U	1.3 U	11.17	53.8	11.18	0.86	0.84	1.89	0.118	1.6 U
364-36	MRR3MSM	6.7 U	1.3 U	11.32	49.1	12.42	1.42	0.75	1.53	0.116	1.6 U
364-37	OOR1MSM	7.6 U	1.4 U	11.57	50.3	12.05	1.66	0.84	1.54	0.116	1.7 U
364-38	OAP3R3MSM	7.5 U	1.6	12.00	47.6	9.52	1.67	0.49	1.38	0.084	1.4 U
364-39	OIR2MSM	7.1 U	1.2 U	12.74	47.5	11.04	0.93	0.91	1.62	0.091	1.5 U
364-40	PS1R1MSM	8.2 U	1.5	12.38	51.5	10.79	2.11	0.46	1.88	0.062	1.6 U
364-41, REP 1	PS3R1MSM	7.5 U	1.4 U	13.05	53.4	11.31	1.30	1.00	2.35	0.058	1.5 U
364-41, REP 2	PS3R2MSM	7.4 U	1.4	12.80	48.9	11.79	2.41	0.86	2.15	0.046	1.6 U
364-42	PS2R3MSM	6.7 U	1.8	14.50	55.6	11.60	1.86	0.81	2.05	0.068	1.5 U
364-43	MRR1MSM	8.4 U	1.4 U	15.30	54.6	11.80	1.60	1.16	1.60	0.116	1.7 U
364-44	MRR2MSM	7.2 U	1.6	19.10	58.5	11.81	1.99	0.84	2.25	0.118	1.5 U
364-45	PS3R3MSM	7.9 U	1.9	12.11	53.9	11.92	1.73	0.79	2.10	0.081	1.6 U
364-46	WRDR3MSM	8.0 U	1.3 U	12.03	51.8	12.01	1.34	0.86	2.74	0.107	1.5 U
364-47	SAR2MSM	7.8 U	1.3 U	15.00	51.7	11.23	1.17	0.86	2.81	0.058	1.6 U
364-48	WRDR2MSM	7.0 U	1.3 U	18.90	60.3	11.53	1.90	2.64	2.48	0.081	1.6 U
364-49	WRR3MSM	7.0 U	1.2 U	10.79	47.8	10.70	1.50	0.78	2.61	0.139	1.6 U
364-50	WRR2MSM	7.1 U	1.2 U	11.49	47.1	9.74	1.31	1.24	1.78	0.061	1.6 U
364-51	PS2RMSM	6.3 U	1.7 U	13.93	55.2	11.89	2.05	0.63	2.40	0.031	1.4 U
364-52	WROR1MSM	6.4 U	1.4 U	12.54	49.7	12.04	1.94	0.63	2.35	0.116	1.8 U
364-53	SAR3MSM	7.5 U	1.3 U	16.10	56.4	10.84	1.59	0.79	2.86	0.067	1.6 U
364-54	OIR3MSM	8.2 U	1.4 U	15.90	49.1	11.31	1.82	0.95	1.90	0.066	1.6 U
364-55	OIR3MSM	8.1 U	1.4 U	14.10	60.3	12.70	1.73	1.55	2.25	0.060	1.7 U
364-56	OIR1MSM	7.2 U	1.4 U	13.07	54.9	12.00	1.59	1.10	2.31	0.070	1.8 U
364-57	OOR3MSM	6.4 U	1.2 U	12.22	64.3	9.94	1.67	0.80	1.85	0.028	1.7 U
364-58	PS3R1MSM	8.1 U	1.4 U	11.79	52.8	10.77	1.96	0.67	2.35	0.030	1.7 U
364-59	SAR1MSM	7.7 U	1.3 U	13.04	57.2	10.17	1.81	0.95	3.35	0.021	1.7 U
364-60	WR1MSM	7.0 U	1.3 U	14.10	53.7	12.73	1.93	0.83	1.88	0.029	1.5 U
364-61	BRHR3MSM	10.1	2.6	46.40	95.1	8.46	1.76	1.13	2.55	0.043	5.9
364-62	BRHR1MSM	12.5	2.6	106.50	102.3	8.70	1.48	1.65	2.16	0.044	7.4
364-63	BKGMSM	5.1	1.1	13.89	61.1	8.71	1.65	1.07	1.01	0.064	1.3 U
364-64	BKGMSM	5.5	1.0 U	15.35	66.1	10.11	2.17	1.31	1.15	0.067	1.3 U

U = Indicates analyte not detected above detection limits.

WES - OAKLAND HARBOR (CF #364) 11/22/91

METALS CONCENTRATIONS

IN MUSSEL TISSUE SAMPLES

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP/MS	Cd ICP/MS	Hg CVAA	Pb XRF
Blank Rep 1		NA	NA	NA	NA	NA	NA	2.11	3.28	0.001	NA
Blank Rep 2		NA	NA	NA	NA	NA	NA	4.45	0.94	0.001	NA
Blank Rep 3		NA	NA	NA	NA	NA	NA	3.97	1.64	0.002	NA
Blank Rep 4		NA	NA	NA	NA	NA	NA	3.05	0.94	0.002	NA
STANDARD REFERENCE MATERIAL											
1566A-1		4.4	3.5	65.5	838	14.67	2.32	1.51	4.33	0.060	1.2 U
1566A-2		4.4 U	2.8	67.4	843	14.13	2.77	1.42	3.97	0.060	1.5
1566A-3		3.8 U	1.9	65.7	834	14.51	2.29	1.70	4.57	0.059	1.2 U
1566A-4		4.7	1.9	64.5	833	14.06	2.16	1.61	4.18	0.058	1.2 U
	certified value	1.43 ±0.46	2.25 ±0.44	66.3 ±4.3	830 ±57	14 ±1.2	2.21 ±0.24	1.68 ±0.15	4.15 ±0.38	0.064 ±0.0067	0.37 ±0.014
MATRIX SPIKE RESULTS											
364-48											
Amount Spiked		NA	NA	NA	NA	NA	NA	2	2	0.5	NA
Sample Only		NA	NA	NA	NA	NA	NA	2.64	2.48	0.081	NA
Sample + Spike		NA	NA	NA	NA	NA	NA	4.39	5.60	0.535	NA
Amount Recovered		NA	NA	NA	NA	NA	NA	1.75	3.12	0.454	NA
Percent Recovery		NA	NA	NA	NA	NA	NA	88%	156%	91%	NA
364-64											
Amount Spiked		NA	NA	NA	NA	NA	NA	2	2	0.5	NA
Sample Only		NA	NA	NA	NA	NA	NA	1.31	1.15	0.067	NA
Sample + Spike		NA	NA	NA	NA	NA	NA	3.58	3.54	0.394	NA
Amount Recovered		NA	NA	NA	NA	NA	NA	2.27	2.39	0.327	NA
Percent Recovery		NA	NA	NA	NA	NA	NA	114%	120%	65%	NA

NA = Not applicable.
U = Indicates analyte not detected above detection limits.
NC = Not certified.

APPENDIX D

Plant and Animal Mesocosm Test

2. PCB/Pesticide Concentrations in Mussel Tissue

Sediment	Sample Number	Sponsor Code
Marine Reference	364-43	MRR1
	364-44	MRR2
	364-36	MRR3
Sand Reference	364-47	SAR2
	364-53	SAR3
	364-59	SAR1
Blackrock Harbor	364-61	BRHR3
	364-62	BRHR1
Pinole Shoal	364-34	OAP3R2
	364-35	OAP3R1
	364-38	OAP3R3
	364-40	PS1R1
	364-41	PS3R2
	364-42	PS2R3
	364-45	PS3R3
	364-51	PS2R2
	364-58	PS3R1
West Richmond	364-46	WRDR3
	364-48	WRDR2
	364-49	WRR3
	364-50	WRR2
	364-52	WRDR1
	364-60	WRR1

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

11/21/91

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	BLANK-1	OAP3R2MSM	OAP3R1MSM	MRR3MSM	OOR1MSM	OAP3R3MSM	OIR2MSM	PS2R1MSM
Sample ID	JP73PB *	364-34	364-35	364-36	364-37	364-38	364-39	364-40
Species	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish
Wet Weight(g)	1.000	30.176	30.435	31.009	30.558	32.824	31.339	30.717
A-BHC	2.480 U	0.082 U	0.081 U	0.153 E	0.131 E	0.076 U	0.178	0.128 E
B-BHC	2.480 U	0.082 U	0.081 U	0.080 U	0.081 U	0.076 U	0.079 U	0.081 U
LINDANE	2.480 U	0.082 U	0.081 U	0.080 U	0.081 U	0.076 U	0.079 U	0.081 U
D-BHC	2.480 U	0.082 U	0.081 U	0.080 U	0.081 U	0.076 U	0.286 E	0.081 U
HEPTACHLOR	5.073 U	0.168 U	0.167 U	0.164 U	0.166 U	0.155 U	0.057 JE	0.165 U
ALDRIN	2.422 U	0.080 U	0.080 U	0.078 U	0.079 U	0.074 U	0.077 U	0.079 U
HEPTACHLOREPOXIDE	2.779 U	0.118	0.095	0.160	0.129	0.208	0.272	0.171
A-ENDOSULFAN	7.109 U	0.252	0.234 U	0.185 J	0.268	0.350	0.206 J	0.208 J
DIELDRIN	25.868 U	0.416 J	0.216 J	0.372 J	0.310 J	0.363 J	0.314 J	0.291 J
PPDDE	3.380 U	2.888	2.444	3.005	3.027	3.314	3.759	2.735
ENDRIN	2.863 JE	0.139 JE	0.154 JE	0.121 JE	0.115 JE	0.743 U	0.778 U	0.794 U
B-ENDOSULFAN	7.109 U	0.530 E	0.453 E	0.718 E	0.527 E	0.618 E	0.684 E	0.502 E
PPDDD	1.671 U	0.347	0.440	0.840	0.859	0.566	0.592	0.481
ENDRIN ALDEHYDE	7.109 U	0.972	0.181 J	0.229 U	0.233 U	0.116 J	0.164 J	0.079 J
ENDOSULFAN SULFATE	7.109 U	0.537	0.626	0.486	0.395	0.546	0.755	0.429
PPDDT	5.215 U	0.517 E	0.546 E	0.685 E	0.594 E	0.669 E	0.650 E	0.548 E
TOXAPHENE	71.089 U	2.356 U	2.336 U	2.293 U	2.326 U	2.166 U	2.268 U	2.314 U
CHLORDANE	71.089 U	2.356 U	2.336 U	2.293 U	2.326 U	2.166 U	2.268 U	2.314 U
Aroclor 1242	71.089 U	2.356 U	2.336 U	2.293 U	2.326 U	2.166 U	2.268 U	2.314 U
Aroclor 1248	71.089 U	2.356 U	2.336 U	2.293 U	2.326 U	2.166 U	2.268 U	2.314 U
Aroclor 1254	71.089 U	39.691	34.697	37.772	38.578	40.761	41.579	27.267
Aroclor 1260	71.089 U	2.356 U	2.336 U	2.293 U	2.326 U	2.166 U	2.268 U	2.314 U
DBOFB (% Rec)	68	92	85	92	93	105	100	119
TCN (% Rec)	77	116	106	108	110	125 &I	117	135 &I

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	PS3R2MSM	PS2R3MSM	MRR1MSM	MRR2MSM	PS3R3MSM	WRDR2MSM	SAR2MSM	WRDR2MSM	WRR3MSM
Sample ID	364-41	364-42	364-43	364-44	364-45	364-46	364-47	364-48	364-49
Species	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish
Wet Weight(g)	30.990	30.727	30.327	30.696	32.026	31.391	31.125	30.255	30.730
A-BHC	0.080 U	0.081 U	0.152 E	0.081 U	0.077 U	0.220 E	0.080 U	0.082 U	0.137 E
B-BHC	0.142 E	0.081 U	0.082 U	0.081 U	0.077 U	0.079 U	0.080 U	0.082 U	0.081 U
LINDANE	0.080 U	0.081 U	0.082 U	0.081 U	0.077 U	0.079 U	0.080 U	0.082 U	0.081 U
D-BHC	0.080 U	0.081 U	0.082 U	0.081 U	0.077 U	0.079 U	0.140 E	0.145 E	0.081 U
HEPTACHLOR	0.164 U	0.165 U	0.010 JE	0.165 U	0.071 JE	0.162 U	0.163 U	0.004 JE	0.165 U
ALDRIN	0.078 U	0.079 U	0.080 U	0.079 U	0.076 U	0.077 U	0.078 U	0.080 U	0.079 U
HEPTACHLOREPOXIDE	0.090 U	0.151	0.270	0.201	0.115	0.116	0.204	0.110	0.148
A-ENDOSULFAN	0.240	0.310	0.189 J	0.172 J	0.243	0.350	0.334	0.351	0.240
DIELDRIN	0.215 J	0.269 J	0.429 J	0.233 J	0.287 J	0.266 J	0.266 J	0.315 J	0.328 J
PPDDE	3.518	2.881	3.117	1.811	2.998	3.224	2.877	2.609	3.105
ENDRIN	0.160 JE	0.794 U	0.804 U	0.795 U	0.146 JE	0.086 JE	0.784 U	0.806 U	0.794 U
B-ENDOSULFAN	0.732 E	0.575 E	0.619 E	0.274 E	0.526 E	0.573 E	0.440 E	0.537 E	0.499 E
PPDDD	0.433	0.550	0.421	0.358	0.052 U	0.552	0.317	0.491	0.323
ENDRIN ALDEHYDE	0.810	0.778	1.078	0.374	0.899	1.012	0.428	0.537	0.207 J
ENDOSULFAN SULFATE	0.537	0.432	0.516	0.394	0.644	0.566	0.638	0.573	0.463
PPDDT	0.991 E	0.744 E	0.931 E	0.357 E	0.495 E	0.609 E	0.590 E	0.498 E	0.623 E
TOXAPHENE	2.294 U	2.314 U	2.344 U	2.316 U	2.220 U	2.265 U	2.284 U	2.350 U	2.313 U
CHLORDANE	2.294 U	2.314 U	2.344 U	2.316 U	2.220 U	2.265 U	2.284 U	2.350 U	2.313 U
Aroclor 1242									
Aroclor 1248	2.294 U	2.314 U	2.344 U	2.316 U	2.220 U	2.265 U	2.284 U	2.350 U	2.313 U
Aroclor 1254	2.294 U	2.314 U	2.344 U	2.316 U	2.220 U	2.265 U	2.284 U	2.350 U	2.313 U
Aroclor 1260	27.897	31.625	36.510	19.203	35.575	37.834	32.916	41.208	37.737
	2.294 U	2.314 U	2.344 U	2.316 U	2.220 U	2.265 U	2.284 U	2.350 U	2.313 U
DBOFB (% Rec)	107	98	110	96	104	94	97	100	86
TCN (% Rec)	112	110	126 &I	115	124 &I	116	110	156 &I	113

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	WRR2MSM	WRR2MSM	Matrix Spike	BLANK-2	PS2R2MSM	WRORIMSM	WRORIMSM	SAR3MSM
Sample ID	364-50	364-50(Repl)	JP71MS	JP86PB	364-51	364-52	4-52(Repl)	364-53
Species	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish
Wet Weight(g)	30.085	30.107	15.252	1.000	11.999	30.038	30.465	30.419
A-BHC	0.122 E	0.123 E	3.851	2.480 U	0.346 E	0.080 JE	0.094 E	0.082 U
B-BHC	0.082 U	0.082 U	5.084	7.185	0.266 E	0.083 U	0.081 U	0.082 U
LINDANE	0.082 U	0.082 U	7.274	6.732 E	4.167 E	2.767 E	3.290 E	2.965 E
D-BHC	0.082 U	0.082 U	5.736	2.480 U	0.207 U	0.256 E	0.381 E	0.082 U
HEPTACHLOR	0.169 U	0.168 U	5.620	5.073 U	0.423 U	0.169 U	0.167 U	0.061 JE
ALDRIN	0.081 U	0.080 U	3.942	5.859 E	0.202 U	0.081 U	0.080 U	0.166
HEPTACHLOREPOXIDE	0.239	0.224	4.003	2.779 U	0.211 J	0.132	0.125	0.213
A-ENDOSULFAN	0.206 J	0.199 J	4.804	7.109 U	0.586 J	0.227 J	0.251	0.297
DIELDRIN	0.265 J	0.235 J	4.534	25.868 U	0.333 J	0.289 J	0.264 J	0.293 J
PPDDE	3.114	2.955	9.130	3.380 U	3.669	2.488	2.607	3.072
ENDRIN	0.811 U	0.810 U	4.376	24.397 U	2.033 U	0.812 U	0.801 U	0.802 U
B-ENDOSULFAN	0.592 E	0.581 E	6.311	7.109 U	0.330 JE	0.379 E	0.284 E	0.428 E
PPDDD	0.391	0.438	7.131	1.671 U	2.888	2.058	0.349	0.441
ENDRIN ALDEHYDE	0.218	0.204 J	0.694	7.109 U	0.246 J	0.363	0.640	0.436
ENDOSULFAN SULFATE	0.564	0.524	4.806	7.109 U	1.121	0.756	0.720	0.731
PPDDT	0.700 E	0.632 E	5.890	5.215 U	0.771 E	0.405 E	0.589 E	0.478 E
TOXAPHENE	2.363 U	2.361 U	4.661 U	71.089 U	5.925 U	2.367 U	2.333 U	2.337 U
CHLORDANE	2.363 U	2.361 U	4.661 U	71.089 U	5.925 U	2.367 U	2.333 U	2.337 U
Aroclor 1242	2.363 U	2.361 U	4.661 U	71.089 U	5.925 U	2.367 U	2.333 U	2.337 U
Aroclor 1248	2.363 U	2.361 U	4.661 U	71.089 U	5.925 U	2.367 U	2.333 U	2.337 U
Aroclor 1254	35.442	34.970	220.234	71.089 U	48.291	35.166	41.626	39.749
Aroclor 1260	2.363 U	2.361 U	4.661 U	71.089 U	5.925 U	2.367 U	2.333 U	2.337 U
DBOFB (% Rec)	109	111	75	62	72	74	66	74
TCN (% Rec)	130 &	133 &I	96	76	96	98	93	109

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	OIR3MSM	OIR3MSM	OIR1MSM	COR3MSM	PS3R1MSM	SAR1MSM	WR1MSM	BRHR3MSM
Sample ID	364-54	364-55	364-56	364-57	364-58	364-59	364-60	364-61
Species	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish
Wet Weight(g)	30.194	20.080	32.060	34.706	31.608	28.152	30.205	20.099
A-BHC	0.154	0.240	0.083 E	0.071 U	0.078 U	0.088 U	0.082 U	0.577 E
B-BHC	0.082 U	0.124 U	0.077 U	0.071 U	0.078 U	0.088 U	0.082 U	0.123 U
LINDANE	3.220 E	3.433 E	2.152 E	2.589 E	3.028 E	3.407 E	4.028 E	4.169 E
D-BHC	0.082 U	0.124 U	0.179 E	0.071 U	0.078 U	0.088 U	0.082 U	0.123 U
HEPTACHLOR	0.033 JE	0.253 U	0.044 JE	0.146 U	0.001 JE	0.180 U	0.168 U	1.698
ALDRIN	0.161	0.121 U	0.116	0.109	0.077 U	0.086 U	0.080 U	0.121 U
HEPTACHLOREPOXIDE	0.132	0.130 J	0.122	0.263	0.143	0.124	0.122	0.138 U
A-ENDOSULFAN	0.300 E	0.273 J	0.184 JE	0.233	0.175 J	0.448	0.336	2.300
DIELDRIN	0.335 J	0.342 J	0.252 J	0.248 J	0.244 J	0.207 J	0.306 J	1.578
PPDDE	3.089	2.506	2.241	2.520	2.333	2.250	3.204	5.077
ENDRIN	0.808 U	1.215 U	0.132 J	0.156 JE	0.169 J	0.867 U	0.808 U	1.214 U
B-ENDOSULFAN	0.492 E	0.408 E	0.310 E	0.411 E	0.272 E	0.523 E	0.377 E	1.325 E
PPDDD	1.486	1.957	1.256	2.120	1.303	1.499	0.443	2.552
ENDRIN ALDEHYDE	0.305	0.091 J	0.187 J	0.248	0.094 J	0.054 J	0.868	5.716
ENDOSULFAN SULFATE	0.755	0.703	0.390	0.601	0.518	1.068	0.528	1.431 E
PPDDT	0.596 E	0.604 E	0.309 E	0.733 E	0.590 E	0.644 E	0.553 E	0.259 U
TOXAPHENE	2.354 U	3.540 U	2.217 U	2.048 U	2.249 U	2.525 U	2.354 U	3.537 U
CHLORDANE	2.354 U	3.540 U	2.217 U	2.048 U	2.249 U	2.525 U	2.354 U	3.537 U
Aroclor 1242	2.354 U	3.540 U	2.217 U	2.048 U	2.249 U	2.525 U	2.354 U	3.537 U
Aroclor 1248	2.354 U	3.540 U	2.217 U	2.048 U	2.249 U	2.525 U	2.354 U	3.537 U
Aroclor 1254	49.706	39.608	39.288	36.318	30.129	29.830	51.564	271.582
Aroclor 1260	2.354 U	3.540 U	2.217 U	2.048 U	2.249 U	2.525 U	2.354 U	3.537 U
DBOFB (% Rec)	79	83	75	88	81	81	72	91
TCN (% Rec)	115	105	111	112	104	101	109	177 &

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

(Concentrations in ug/kg (ppb) Wet Wt.)

Sponsor Code	BRHR1MSM	BKGMSM	BKGMSM	WRR3SNE	BKGSNM	Matrix Spike	Matrix Spike Dup
Sample ID	364-62	364-63	364-64	364-65	364-66	JP84MS	JP85MSD
Species	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish	Shellfish
Wet Weight(g)	14.098	7.920	12.591	5.240	21.649	5.563	5.913
A-BHC	0.356 E	0.667 E	0.635 E	0.748 E	0.656	10.641	9.759
B-BHC	0.847	0.477 E	0.311 E	2.727 E	3.757	14.038	12.452
LINDANE	7.233 E	6.531 E	8.873 E	1.141 E	0.523 E	17.424 E	16.194 E
D-BHC	0.646 E	0.313 U	0.197 U	0.473 U	0.115 U	15.321	14.110
HEPTACHLOR	0.253 JE	0.641 U	0.044 JE	0.135 JE	0.407	16.117	14.482
ALDRIN	0.172 U	0.306 U	0.192 U	0.462 U	0.112 U	11.584	10.771
HEPTACHLOREPOXIDE	0.197 U	0.351 U	0.221 U	0.456 J	0.304	11.855	10.790
A-ENDOSULFAN	2.252	3.243	0.420 J	1.357 U	0.328 U	13.757	19.603
DIELDRIN	1.679 J	1.527 JE	1.181 J	1.255 J	1.214	13.387	13.403
PPDDE	6.643	6.538	5.234	11.301	12.706	22.107	21.686
ENDRIN	1.731 U	3.080 U	1.938 U	4.656 U	1.127 U	17.108	16.810
B-ENDOSULFAN	1.782 E	0.942 E	0.639 E	0.485 JE	2.371 E	18.372	16.847
PPDDD	1.760	1.422	1.059	1.189	2.199	25.127	22.220
ENDRIN ALDEHYDE	5.948	1.863	1.477	1.413	6.677 E	1.399	1.144
ENDOSULFAN SULFATE	0.517	0.898 U	0.786	0.469 JE	0.789 E	18.086	16.107
PPDDT	1.207 E	1.047 E	1.452 E	0.995 U	0.241 U	18.653 E	17.065 E
TOXAPHENE	5.042 U	8.976 U	5.646 U	13.567 U	3.284 U	12.779 U	12.022 U
CHLORDANE	5.042 U	8.976 U	5.646 U	13.567 U	3.284 U	12.779 U	12.022 U
Aroclor 1242	5.042 U	8.976 U	5.646 U	13.567 U	3.284 U	12.779 U	12.022 U
Aroclor 1248	5.042 U	8.976 U	5.646 U	13.567 U	3.284 U	12.779 U	12.022 U
Aroclor 1254	212.440	86.037	91.711	120.404	379.050	550.955	464.753
Aroclor 1260	5.042 U	8.976 U	5.646 U	13.567 U	3.284 U	12.779 U	12.022 U
DBOFB (% Rec)	79	84	79	89	83	77	73
TCN (% Rec)	115	111	129 &	112	144 &	107	97

B - Blank corrected
ND - Non Detected * Procedural Blank Reported in ng
DO - Diluted Out
J - Value below reporting limit
C - Detection confirmed on second column
& - Surrogate Recovery out of range

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

11/21/91

	Sample Number	Sample Wet Weight(g)
Backgroung Sample:	364-39	31.339
Matrix Spike Sample:	JP71MS	15.252
Matrix Spike Duplicate:	JP72MSD	15.469

Analyte	MS Conc (ug/kg)	MSD Conc (ug/kg)	Background Conc (ug/kg)	MS Spike(ug)	MSD Spike(ug)	MS Recovery	MSD Recovery
A-BHC	3.851	3.864	0.178	80	80	70	71
B-BHC	5.084	5.360	0.000 ND	80	80	97	104
LINDANE	7.274	6.508	0.000 ND	80	80	139	126
D-BHC	5.736	5.902	0.286 E	80	80	104	109
HEPTACHLOR	5.620	5.476	0.057 JE	80	80	106	105
ALDRIN	3.942	3.674	0.000 ND	80	80	75	71
HEPTACHLOREPOXIDE	4.003	3.849	0.272	80	80	71	69
A-ENDOSULFAN	4.804	4.723	0.206 J	80	80	88	87
DIELDRIN	4.534	4.407	0.314 J	80	80	80	79
PPDDE	9.130	8.874	3.759	80	80	102	99
ENDRIN	4.376	4.212	0.000 ND	80	80	83	81
B-ENDOSULFAN	6.311	6.138	0.684 E	80	80	107	105
PPDDD	7.131	6.540	0.592	80	80	125	115
ENDRIN ALDEHYDE	0.694	0.651	0.164 J	80	80	10	9
ENDOSULFAN SULFATE	4.806	4.816	0.755	80	80	77	79
PPDDT	5.890	5.645	0.650 E	80	80	100	97
Aroclor 1254	220.234	217.844	41.579	2000	2000	136	136
DBOFB (% Rec)			100			75	79
TCN (% Rec)			117			96	107

ND - Not Detected
NA - Not Applicable
J - Indicates value below MDL
& - Surrogate recovery outside of specified range
E - Estimated value

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

Sample No.	Sample Size (g)
364-50	30.085
364-50(Repl)	30.107

Analyte	Sample Conc(ug/Kg)	Duplicate Conc(ug/Kg)	I-Stat	% RPD
A-BHC	0.122 E	0.123 E	0.000	1
B-BHC	0.000 ND	0.000 ND	NA	NA
LINDANE	0.000 ND	0.000 ND	NA	NA
CL3(18)	0.000 ND	0.000 ND	NA	NA
D-BHC	0.000 ND	0.000 ND	NA	NA
CL3(28)	0.289	0.316	0.050	9
HEPTACHLOR	0.000 ND	0.000 ND	NA	NA
CL4(52)	0.618	0.674	0.040	9
ALDRIN	0.000 ND	0.000 ND	NA	NA
CL4(44)	0.122	0.132	0.040	8
HEPTACHLOREPOXIDE	0.239	0.224	0.030	6
CL4(66)	0.400	0.405	0.010	1
A-ENDOSULFAN	0.206 J	0.199 J	0.020	3
CL5(101)	1.739	1.786	0.010	3
DIELDRIN	0.265 J	0.235 J	0.060	12
PPDDE	3.114	2.955	0.030	5
CL4(77)	0.000 ND	0.000 ND	NA	NA
ENDRIN	0.000 ND	0.000 ND	NA	NA
B-ENDOSULFAN	0.592 E	0.581 E	0.010	2
CL5(118)	2.337	2.555	0.050	9
PPDDD	0.391	0.438	0.060	11
ENDRIN ALDEHYDE	0.218	0.204 J	0.030	7
CL6(153)	3.357	3.322	0.010	1
CL5(105)	0.203	0.217	0.030	7
ENDOSULFAN SULFATE	0.564	0.524	0.040	7
PPDDT	0.700 E	0.632 E	0.050	10
CL6(138)	2.182	2.058	0.030	6
CL5(126)	0.000 ND	0.000 ND	NA	NA
CL7(187)	1.466	1.307	0.060	11
CL6(128)	0.261	0.258	0.010	1
CL7(180)	0.000 ND	0.000 ND	NA	NA
CL7(170)	0.049 J	0.054 J	0.050	10
CL8(195)	0.000 ND	0.000 ND	NA	NA
CL9(206)	0.000 ND	0.000 ND	NA	NA
CL10(209)	0.000 ND	0.000 ND	NA	NA
TOXAPHENE	0.000 ND	0.000 ND	NA	NA
CHLORDANE	0.000 ND	0.000 ND	NA	NA
Aroclor 1242	0.000 ND	0.000 ND	NA	NA
Aroclor 1248	0.000 ND	0.000 ND	NA	NA
Aroclor 1254	35.442	34.970	0.010	1
Aroclor 1260	0.000 ND	0.000 ND	NA	NA
DBOFB	109	111		
TCN	130 &I	133 &I		

J - Indicates values MDL
ND - Not Detected
NA - Not Applicable

E - Estimated Value
& - Surrogate Recovery Out of Specified range
I - Interfering peak(Aroclor Congener)

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

	Sample No.	Sample Size (g)
	364-52	30.038
Duplicate Sample:	364-52(Repl)	30.465

Analyte	Sample Conc(ug/Kg)	Duplicate Conc(ug/Kg)	I-Stat	% RPD
A-BHC	0.080 JE	0.094 E	0.080	16
B-BHC	0.000 ND	0.000 ND	NA	NA
LINDANE	2.767 E	3.290 E	0.090	17
CL3(18)	0.085 J	0.000 ND	1.000	200 &
D-BHC	0.256 E	0.381 E	0.200	39 &
CL3(28)	0.259	0.491	0.310	62 &
HEPTACHLOR	0.000 ND	0.000 ND	NA	NA
CL4(52)	0.743	0.806	0.040	8
ALDRIN	0.000 ND	0.000 ND	NA	NA
CL4(44)	0.159	0.138	0.070	14
HEPTACHLOREPOXIDE	0.132	0.125	0.030	5
CL4(66)	0.533	0.555	0.020	4
A-ENDOSULFAN	0.227 J	0.251	0.050	10
CL5(101)	1.874	1.866	0.000	0
DIELDRIN	0.289 J	0.264 J	0.050	9
PPDDE	2.488	2.607	0.020	5
CL4(77)	0.000 ND	0.000 ND	NA	NA
ENDRIN	0.000 ND	0.000 ND	NA	NA
B-ENDOSULFAN	0.379 E	0.284 E	0.140	29 &
CL5(118)	1.987	2.369	0.090	18
PPDDD	2.058	0.349	0.710	142 &
ENDRIN ALDEHYDE	0.363	0.640	0.280	55 &
CL6(153)	2.569	3.051	0.090	17
CL5(105)	0.396	0.377	0.030	5
ENDOSULFAN SULFATE	0.756	0.720	0.020	5
PPDDT	0.405 E	0.589 E	0.190	37 &
CL6(138)	1.732	2.154	0.110	22 &
CL5(126)	0.000 ND	0.000 ND	NA	NA
CL7(187)	1.280	1.215	0.030	5
CL6(128)	0.092 J	0.138	0.200	40 &
CL7(180)	0.002 J	0.112	0.970	193 &
CL7(170)	0.021 J	0.020 J	0.020	5
CL8(195)	0.000 ND	0.000 ND	NA	NA
CL9(206)	0.000 ND	0.000 ND	NA	NA
CL10(209)	0.000 ND	0.000 ND	NA	NA
TOXAPHENE	0.000 ND	0.000 ND	NA	NA
CHLORDANE	0.000 ND	0.000 ND	NA	NA
Aroclor 1242	0.000 ND	0.000 ND	NA	NA
Aroclor 1248	0.000 ND	0.000 ND	NA	NA
Aroclor 1254	35.166	41.626	0.080	17
Aroclor 1260	0.000 ND	0.000 ND	NA	NA
DBOFB	74	66		
TCN	98	93		

J - Indicates values MDL
ND - Not Detected
NA - Not Applicable

E - Estimated Value
& - Surrogate Recovery Out of Specified range
I - Interfering peak(Aroclor Congener)

WES BALDWIN (CF #364)
PCB/PESTICIDE RESULTS
IN TISSUE SAMPLES

	Sample Number	Sample Wet Weight(g)
Backgroung Sample:	364-60	30.205
Matrix Spike Sample:	JP84MS	5.563
Matrix Spike Duplicate:	JP85MSD	5.913

Analyte	MS Conc (ug/kg)	MSD Conc (ug/kg)	Background Conc (ug/kg)	MS Spike(ug)	MSD Spike(ug)	MS Recovery	MSD Recovery	RPD	I-Stat
A-BHC	10.641	9.759	0.000 ND	80	80	74	72	9	0.043
B-BHC	14.038	12.452	0.000 ND	80	80	98	92	12	0.06
LINDANE	17.424	16.194	4.028 E	80	80	93	90	7	0.037
D-BHC	15.321	14.110	0.000 ND	80	80	107	104	8	0.041
HEPTACHLOR	16.117	14.482	0.000 ND	80	80	112	107	11	0.053
ALDRIN	11.584	10.771	0.000 ND	80	80	81	80	7	0.036
HEPTACHLOREPOXIDE	11.855	10.790	0.122	80	80	82	79	9	0.047
A-ENDOSULFAN	13.757	19.603	0.336	80	80	93	142	35 &	0.175
DIELDRIN	13.387	13.403	0.306 J	80	80	91	97	0	0.001
PPDDE	22.107	21.686	3.204	80	80	131	137	2	0.01
ENDRIN	17.108	16.810	0.000 ND	80	80	119	124	2	0.009
B-ENDOSULFAN	18.372	16.847	0.377 E	80	80	125	122	9	0.043
PPDDD	25.127	22.220	0.443	80	80	172 &	161	12	0.061
ENDRIN ALDEHYDE	1.399	1.144	0.868	80	80	4	2	20	0.1
ENDOSULFAN SULFATE	18.086	16.107	0.528	80	80	122	115	12	0.058
PPDDT	18.653	17.065	0.553 E	80	80	126	122	9	0.044
Aroclor 1254	550.955	464.753	51.564	2000	2000	139 &	122 &	17	0.085
DBOFB (% Rec)			72			77	73		
TCN (% Rec)			109			107	97		

ND - Not Detected
NA - Not Applicable
J - Indicates value below MDL
& - Surrogate recovery outside of specified range

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APPENDIX D

Plant and Animal Mesocosm Test

3. PAH Concentrations in Mussel Tissue

Sediment	Sample Number	Sponsor Code
Marine Reference	364-43	MRR1
	364-44	MRR2
	364-36	MRR3
Sand Reference	364-47	SAR2
	364-53	SAR3
	364-59	SAR1
Blackrock Harbor	364-61	BRHR3
	364-62	BRHR1
Pinole Shoal	364-34	OAP3R2
	364-35	OAP3R1
	364-38	OAP3R3
	364-40	PS1R1
	364-41	PS3R2
	364-42	PS2R3
	364-45	PS3R3
	364-51	PS2R2
	364-58	PS3R1
West Richmond	364-46	WRDR3
	364-48	WRDR2
	364-49	WRR3
	364-50	WRR2
	364-52	WRDR1
	364-60	WRR1

WES-OAKLAND HARBOR (CF #364) 11/7/91
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

Battelle Code	Blank-1	364-34	364-35	364-36	364-37	364-38	364-39	364-40	364-41
Sponsor ID	JP73PB	OAP3R2MSM	OAP3R1MSM	MRR3MSM	OOR1MSM	OAP3R3MSM	OIR2MSM	PS2R1MSM	PS3R2MSM
Wet Weight(g)	1	30.176	30.435	31.009	30.558	32.824	31.339	30.717	30.99
naphthalene	20.27 J	133.96	78.64	73.26	99.39	62.96	77.07	63.56	111.18
acenaphthylene	40.14 U	2.53	1.35	1.11 J	1.58	1.23	1.81	0.71 J	2.23
acenaphthene	21.68 U	9.61	4.43	4.08	4.89	4.49	6.55	1.78	7.69
fluorene	23.47 U	4.51	1.44	1.4	1.51	2.02	3.27	1.04	3.19
phenanthrene	4.86 J	57.75	27.39	26.75	32.2	28.99	50.49	17.79	50.29
anthracene	17.77 U	0.76	0.29 J	0.28 J	0.36 J	0.64	0.95	0.23 J	0.27 J
fluoranthene	5.85 J	2.74	1.54	0.65	1.06	2.71	1.49	0.74	0.84
pyrene	20.86 J	24.8	10.78	2.43	4.74	20.26	10.43	1.61	2.68
benz[a]anthracene	3.89 J	0.63 J	0.24 J	0.12 J	0.2 J	1.23	0.27 J	0.14 J	0.13 J
chrysene	6.76 J	1.3	0.52 J	0.31 J	0.45 J	1.28	0.69	0.22 J	0.25 J
benzo[b]fluoranthene	8.51 J	0.8 J	0.35 J	0.07 J	0.23 J	0.66 J	0.54 J	0.99 U	0.07 J
benzo[k]fluoranthene	4.63 J	0.45 J	0.17 J	0.07 J	0.14 J	0.36 J	0.25 J	0.83 U	0.06 J
benzo[a]pyrene	26.42 U	0.31 J	0.1 J	0.85 U	0.87 U	0.35 J	0.2 J	0.86 U	0.85 U
indeno[1,2,3-c,d]pyrene	5.65 J	1.05 U	1.04 U	1.02 U	1.04 U	0.97 U	1.01 U	1.03 U	1.02 U
dibenz[a,h]anthracene	21.54 U	0.71 U	0.71 U	0.7 U	0.71 U	0.66 U	0.69 U	0.7 U	0.7 U
benzo[g,h,i]perylene	6.71 J	1.77	1.41 U	0.2 J	1.41 U	0.86 J	0.62 J	1.4 U	1.39 U
naphthalene-d8 (% Rec)	70	85	77	83	82	84	82	80	84
acenaphthene-d10 (% Rec)	73	89	87	89	92	88	87	87	90
benzo[a]pyrene-d12 (% Rec)	77	81	78	85	85	81	71	83	85

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL in ng/g
& - Surrogate Recovery out of range
B - Blank Corrected

WES-OAKLAND HARBOR (CF #364)
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

Battelle Code	364-42	364-43	364-44	364-45	364-46	364-47	364-48	364-49	364-50	364-50(RI)
Sponsor ID	PS2R3MSM	MRR1MSM	MRR2MSM	PS3R3MSM	WRDR2MSM	SAR2MSM	WRDR2MSM	WRR3MSM	WRR2MSM	WRR2MSM
Wet Weight(g)	30.727	30.327	30.696	32.026	31.391	31.125	30.255	30.73	30.085	30.107
naphthalene	89.57	100.7	69.6	83.17	96.65	89.52	98.14	93.91	63.26	64.68
acenaphthylene	2.22	1.87	1.75	1.26	2.95	1.6	1.96	2.89	1.53	1.61
acenaphthene	7.48	7.55	5.85	4.27	10.68	6.47	7.71	9.7	5.73	5.68
fluorene	4.82	1.81	2.37	2.34	7.18	1.9	3.88	4.61	1.98	1.75
phenanthrene	64.75	22.85	37.17	35.11	78.5	19.01	50.18	59.14	35.5	35.46
anthracene	0.37 J	0.26 J	0.19 J	0.31 J	0.65	0.36 J	0.38 J	0.4 J	0.23 J	0.46 J
fluoranthene	0.61	0.95	0.51 J	0.59	2.24	1.29	1.55	1.22	0.85	0.83
pyrene	1.93	4.8	1.53	2.52	6.75	2.44	5.78	4.58	2.08	2.2
benz[a]anthracene	0.15 J	0.18 J	0.11 J	0.12 J	0.3 J	0.3 J	0.36 J	0.15 J	0.11 J	0.15 J
chrysene	0.24 J	0.47 J	0.23 J	0.28 J	0.59 J	0.39 J	0.79	0.35 J	0.28 J	0.32 J
benzo[b]fluoranthene	0.09 J	0.11 J	0.1 J	0.95 U	0.31 J	0.24 J	0.39 J	0.16 J	0.19 J	0.12 J
benzo[k]fluoranthene	0.08 J	0.11 J	0.08 J	0.79 U	0.19 J	0.2 J	0.19 J	0.13 J	0.14 J	0.11 J
benzo[a]pyrene	0.06 J	0.87 U	0.86 U	0.21 J	0.16 J	0.17 J	0.87 U	0.86 U	0.08 J	0.88 U
indeno[1,2,3-c,d]pyrene	1.03 U	1.04 U	1.03 U	0.99 U	1.01 U	1.02 U	1.05 U	1.03 U	1.05 U	1.05 U
dibenz[a,h]anthracene	0.7 U	0.71 U	0.7 U	0.67 U	0.69 U	0.2 J	0.71 U	0.7 U	0.72 U	0.72 U
benzo[g,h,i]perylene	1.4 U	1.42 U	1.4 U	0.22 J	0.87 J	1.38 U	0.91 J	0.49 J	0.37 J	0.35 J
naphthalene-d8 (% Rec)	85	81	81	79	85	80	81	72	85	82
acenaphthene-d10 (% Rec)	90	87	89	89	87	84	84	76	91	88
benzo[a]pyrene-d12 (% Rec)	87	83	84	83	85	81	80	73	89	86

* - Procedural Blank Reported In n
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL
& - Surrogate Recovery out of ran(
B - Blank Corrected

WES-OAKLAND HARBOR (CF #364) 11/7/91

PAH CONCENTRATIONS

IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

Battelle Code	BLANK-2	364-51	364-52	364-52(R1)	364-53	364-54	364-55	364-56	364-57
Sponsor ID	JP86PB	PS2R2MSM	WRORIMSM	WRORIMSM	SAR3MSM	OIR3MSM	OIR3MSM	OIR1MSM	OOR3MSM
Wet Weight(g)	1.000	11.999	30.038	30.465	30.419	30.194	20.080	32.060	34.706
naphthalene	17.83 J	172.19	110.76	111.71	49.18	56.81	59.04	59.61	92.28
acenaphthylene	40.14 U	5.91	1.03 J	1.13 J	1.24 J	1.34	1.35 J	0.92 J	2.06
acenaphthene	21.68 U	25.08	3.15	3.31	3.83	4.47	4.33	2.4	7.66
fluorene	23.47 U	4.95	1.57	1.72	1.92	2.87	2.85	0.76	2.01
phenanthrene	6.61 J	58.88	29.29	29.54	34.61	48.74	38.51	15.12	40.21
anthracene	17.77 U	0.45 J	0.32 J	0.35 J	0.36 J	0.46 J	0.39 J	0.47 J	0.18 J
fluoranthene	10.23 J	0.99 J	1.95	2.05	2.65	2.87	1.37	1.69	1.69
pyrene	58.51	5.62	6.05	5.89	5.69	15.56	12.91	8.28	6.57
benz[a]anthracene	29.68 U	0.37 J	0.32 J	0.28 J	0.67 J	0.29 J	0.35 J	0.26 J	0.32 J
chrysene	20.8 U	0.52 J	0.73	0.69	1.57	0.94	0.7 J	0.53 J	0.81
benzo[b]fluoranthene	30.29 U	0.3 J	0.34 J	0.35 J	0.62 J	0.36 J	0.39 J	0.3 J	0.24 J
benzo[k]fluoranthene	25.37 U	0.18 J	0.16 J	0.26 J	0.36 J	0.16 J	0.27 J	0.17 J	0.18 J
benzo[a]pyrene	26.42 U	2.2 U	0.11 J	0.16 J	0.12 J	0.15 J	1.32 U	0.14 J	0.14 J
indeno[1,2,3-c,d]pyrene	31.67 U	0.19 J	1.05 U	1.04 U	1.04 U	1.05 U	1.58 U	0.99 U	0.91 U
dibenz[a,h]anthracene	21.54 U	1.8 U	0.72 U	0.71 U	0.71 U	0.71 U	1.07 U	0.67 U	0.62 U
benzo[g,h,i]perylene	42.95 U	1.04 J	0.37 J	0.45 J	0.59 J	0.53 J	0.61 J	0.37 J	0.45 J
naphthalene-d8 (% Rec)	59	63	66	52	64	64	71	56	62
acenaphthene-d10 (% Rec)	59	63	67	53	64	65	70	61	65
benzo[a]pyrene-d12 (% Rec)	60	66	68	56	68	70	76	62	67

• - Procedural Blank Reported in ng

ND - Non Detected

DO - Diluted Out

J - Value below MDL

U - Not Detected reported as MDL in ng/g

& - Surrogate Recovery out of range

B - Blank Corrected

WES-OAKLAND HARBOR (CF #364)
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

Battelle Code	364-58	364-59	364-60	364-61	364-62	364-63	364-64	364-65	364-66
Sponsor ID	PS3R1MSM	SAR1MSM	WR1MSM	BRHR3MSM	BRHR1MSM	BKGMSM	BKGMSM	BKGSN	BKGSN
Wet Weight(g)	31.608	28.152	30.205	20.099	14.098	7.920	12.591	5.240	21.649
naphthalene	70.86	99.44	107.85	87.09	167.88	243.57	224.93	7.29 J	16.94
acenaphthylene	1.36	2.08	2.58	3.05	6.27	11.3	9.81	7.66 U	1.09 J
acenaphthene	4.81	6.87	9.03	16.29	34.32	57.2	55.63	4.14 U	2.39
fluorene	2.4	3.77	3.82	6.02	18.07	40.64	46.7	2.35 J	2.87
phenanthrene	42.73	46.63	42.44	67.56	149.86	240.59	306.96	11.06	18.89
anthracene	0.22 J	0.23 J	0.82	3.15	2.32	5.18	8.06	1.03 J	2.41
fluoranthene	0.88	0.81	2.07	65.74	32.15	25.77	28.6	13.69	42.56
pyrene	1.78	2.73	4.27	96.96	71.2	81.27	66.18	14.77	42.98
benz[a]anthracene	0.14 J	0.21 J	0.29 J	19.25	10.08	7.22	5.81	1.75 J	9.91
chrysene	0.35 J	0.35 J	0.74	29.58	16.72	10.86	10.65	4.09	15.74
benzo[b]fluoranthene	0.13 J	0.12 J	0.32 J	19.32	12.28	6.09	4.52	1.08 J	12.78
benzo[k]fluoranthene	0.13 J	0.05 J	0.17 J	13.02	7.11	3.52	1.71 J	1.12 J	12.77
benzo[a]pyrene	0.84 U	0.94 U	0.12 J	7.43	4.11	1.22 J	0.57 J	5.04 U	8.4
indeno[1,2,3-c,d]pyrene	1 U	1.13 U	1.05 U	4.94	3.56	1.18 J	0.69 J	6.04 U	1.46 U
dibenz[a,h]anthracene	0.68 U	0.77 U	0.71 U	0.9 J	0.68 J	2.72 U	1.71 U	4.11 U	1 U
benzo[g,h,i]perylene	0.13 J	1.53 U	0.58 J	7.25	6.36	6.45	4.77	0.59 J	1.98 U
naphthalene-d8 (% Rec)	63	61	58	70	65	67	60	69	64
acenaphthene-d10 (% Rec)	64	62	60	77	67	66	63	71	70
benzo[a]pyrene-d12 (% Rec)	68	67	64	78	68	73	69	76	70

* - Procedural Blank Reported in n
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL
& - Surrogate Recovery out of ran(
B - Blank Corrected

WES-OAKLAND HARBOR (CF #364) 11/7/91
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

	Sample Number	Sample Wet Weight(g)
Background Sample :	364-39	31.339
Matrix Spike Sample:	JP71MS	15.252
Matrix Spike Dup Sample:	JP72MSD	15.469

Analyte	MS Conc (ug/Kg)	MSD Conc (ug/Kg)	Background Amount(ug/Kg)	MS Spike	MSD Spike	MS% Recovery	MSD% Recovery	RPD	I-Stat
naphthalene	131.55	128.07	77.07	800	800	104	99	3	0.013
acenaphthylene	51.83	52.93	1.81	800	800	95	99	2	0.011
acenaphthene	58.75	57.67	6.55	800	800	100	99	2	0.009
fluorene	54.79	54.22	3.27	800	800	98	99	1	0.005
phenanthrene	99.26	100.45	50.49	800	800	93	97	1	0.006
anthracene	46.71	46.37	0.95	800	800	87	88	1	0.004
fluoranthene	46.29	46.91	1.49	800	800	85	88	1	0.007
pyrene	54.27	55.7	10.43	800	800	84	88	3	0.013
benz[a]anthracene	40.88	42.43	0.27 J	800	800	77	82	4	0.019
chrysene	42.43	42.92	0.69	800	800	80	82	1	0.006
benzo[b]fluoranthene	56.74	55.22	0.54 J	800	800	107	106	3	0.014
benzo[k]fluoranthene	58.35	56.68	0.25 J	800	800	111	109	3	0.015
benzo[a]pyrene	53.31	52.66	0.2 J	800	800	101	101	1	0.006
indeno[1,2,3-c,d]pyr	53.52	54.26	0.00 ND	800	800	102	105	1	0.007
dibenz[a,h]anthracen	50.94	51.52	0.00 ND	800	800	97	100	1	0.006
benzo[g,h,i]perylene	49.25	49.84	0.62 J	800	800	93	95	1	0.006
naphthalene-d8 (% Rec)			82			86	83		
acenaphthene-d10 (% Rec)			87			92	91		
benzo[a]pyrene-d12 (% Rec)			71			82	82		

ND - Not Detected
NA - Not Applicable
J - Indicates value below reporting limit
& - Recovery outside of specified range

WES-OAKLAND HARBOR (CF #364)
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

	Sample Number	Sample Wet Weight(g)
Original Sample:	364-50	30.085
Duplicate Sample:	364-50(Repl)	30.107

Analyte	Sample Conc(ug/Kg)	Duplicate Conc(ug/Kg)	I-Stat	%RPD
naphthalene	63.26	64.68	0.01	2
acenaphthylene	1.53	1.61	0.03	5
acenaphthene	5.73	5.68	0.00	0
fluorene	1.98	1.75	0.06	12
phenanthrene	35.50	35.46	0.00	0
anthracene	0.23 J	0.46 J	0.33	67 &
fluoranthene	0.85	0.83	0.01	2
pyrene	2.08	2.20	0.03	6
benz[a]anthracene	0.11 J	0.15 J	0.15	31 &
benzo[b]fluoranthene	0.19 J	0.12 J	0.23	45 &
benzo[k]fluoranthene	0.14 J	0.11 J	0.12	24 &
benzo[a]pyrene	0.08 J	0.00 ND	1.00	# &
indeno[1,2,3-c,d]pyrene	0.00 ND	0.00 ND	NA	NA
dibenz[a,h]anthracene	0.00 ND	0.00 ND	NA	NA
benzo[g,h,i]perylene	0.37 J	0.35 J	0.03	6
naphthalene-d8	85	82		
acenaphthene-d10	91	88		
benzo[a]pyrene-d12	89	86		

J - Indicates values below MDL.
M - Matrix Interference
ND - Not Detected

WES-OAKLAND HARBOR (CF #364)
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

	Sample Number	Sample Wet Weight(g)
Background Sample :	364-60	30.205
Matrix Spike Sample:	JP84MS	5.563
Matrix Spike Dup Sample:	JP85MSD	5.913

Analyte	MS Conc (ug/Kg)	MSD Conc (ug/Kg)	Background Amount(ug/Kg)	MS Spike	MSD Spike	MS% Recovery	MSD% Recovery	RPD	I-Stat
naphthalene	251.68	241.68	107.85	800	800	100	99	4	0.02
acenaphthylene	153.2	144.84	2.58	800	800	105	105	6	0.028
acenaphthene	154.45	149.97	9.03	800	800	101	104	3	0.015
fluorene	153.94	149.97	3.82	800	800	104	108	3	0.013
phenanthrene	201.33	203.67	42.44	800	800	110	119	1	0.006
anthracene	148.43	146.86	0.82	800	800	103	108	1	0.005
fluoranthene	163.02	164.61	2.07	800	800	112	120	1	0.005
pyrene	165.77	168.13	4.27	800	800	112	121	1	0.007
benz[a]anthracene	158.79	169.2	0.29 J	800	800	110	125	6	0.032
chrysene	163.68	174.54	0.74	800	800	113	128	6	0.032
benzo[b]fluoranthene	159.86	144.9	0.32 J	800	800	111	107	10	0.049
benzo[k]fluoranthene	162.01	151.75	0.17 J	800	800	113	112	7	0.033
benzo[a]pyrene	149.51	143	0.12 J	800	800	104	106	4	0.022
indeno[1,2,3-c,d]pyr	138.85	123.63	0 ND	800	800	97	91	12	0.058
dibenz[a,h]anthracen	130.95	119.36	0 ND	800	800	91	88	9	0.046
benzo[g,h,i]perylene	125.82	116.75	0.58 J	800	800	87	86	7	0.037
naphthalene-d8 (% Rec)			58			72	63		
acenaphthene-d10 (% Rec)			60			74	62		
benzo[a]pyrene-d12 (% Rec)			64			79	68		

ND - Not Detected
NA - Not Applicable
J - Indicates value below reporting limit
& - Recovery outside of specified range

WES-OAKLAND HARBOR (CF #364)
PAH CONCENTRATIONS
IN TISSUE SAMPLES

(concentrations in ug/g (pppm))

	Sample Number	Sample Size(g)
Original Sample:	364-52	30.038
Duplicate Sample:	364-52(Repl)	30.465

Analyte	Sample Conc(ug/Kg)	Duplicate Conc(ug/Kg)	I-Stat	%RPD
naphthalene	110.76	111.71	0.00	0
acenaphthylene	1.03 J	1.13 J	0.05	9
acenaphthene	3.15	3.31	0.03	5
fluorene	1.57	1.72	0.05	9
phenanthrene	29.29	29.54	0.00	0
anthracene	0.32 J	0.35 J	0.05	9
fluoranthene	1.95	2.05	0.03	5
pyrene	6.05	5.89	0.01	3
benz[a]anthracene	0.32 J	0.28 J	0.07	13
chrysene	0.73	0.69	0.03	6
benzo[b]fluoranthene	0.34 J	0.35 J	0.01	3
benzo[k]fluoranthene	0.16 J	0.26 J	0.24	48 &
benzo[a]pyrene	0.11 J	0.16 J	0.19	37 &
indeno[1,2,3-c,d]pyrene	0.00 ND	0.00 ND	NA	NA
dibenz[a,h]anthracene	0.00 ND	0.00 ND	NA	NA
benzo[g,h,i]perylene	0.37 J	0.45 J	0.10	20
naphthalene-d8	66	52		
acenaphthene-d10	67	53		
benzo[a]pyrene-d12	68	56		

J - Indicates values below MDL.
M - Matrix Interference
ND - Not Detected

APPENDIX D

Plant and Animal Mesocosm Test

4. Organotin Analysis of Mussel Tissue

Sediment	Sample Number	Sponsor Code
Marine Reference	364-43	MRR1
	364-44	MRR2
	364-36	MRR3
Sand Reference	364-47	SAR2
	364-53	SAR3
	364-59	SAR1
Blackrock Harbor	364-61	BRHR3
	364-62	BRHR1
Pinole Shoal	364-34	OAP3R2
	364-35	OAP3R1
	364-38	OAP3R3
	364-40	PS1R1
	364-41	PS3R2
	364-42	PS2R3
	364-45	PS3R3
	364-51	PS2R2
	364-58	PS3R1
West Richmond	364-46	WRDR3
	364-48	WRDR2
	364-49	WRR3
	364-50	WRR2
	364-52	WRDR1
	364-60	WRR1

11/21/91

WES JF BALDWIN (CF #364)
ORGANOTIN ANALYSIS
OF TISSUE SAMPLES

(concentrationa in ng/g)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Tetra Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
364-34	OAP3R2MSM	50.2	4.3 U	22.2	8.4	2.6 U
364-35	OPA3R1MSM	40.4	4.4 U	11.8	7.8	2.6 U
364-36	MRR3MSM	48.5	4.6 U	3.4 U	2.8 U	2.8 U
364-37	OOR1MSM	32.6	4.7 U	13.4	2.8 U	2.8 U
364-38	OAP3R3MSM	62.4	5.7 U	31.6	10.5	3.4 U
364-39	OIR2MSM	60.5	5.7 U	11.8	8.9 U	3.4 U
364-40	PS2R1MSM	51.8	6.0 U	4.5 U	3.6 U	3.6 U
364-41, REP 1	PS3R2MSM	39.4	7.0 U	5.3 U	4.2 U	4.2 U
364-41, REP 2	PS2R3MSM	67.1	6.4 U	11.3 U	9.1 U	3.9 U
364-42	PS2R3MSM	71.9	5.4 U	10.5	3.2 U	3.2 U
364-43	MRR1MSM	27.2	4.1 U	3.0 U	2.5 U	2.5 U
364-44	MRR2MSM	56.9	5.4 U	7.2 U	3.3 U	3.3 U
364-45	PS3R3MSM	49.1	4.9 U	7.2 U	5.7 U	2.9 U
364-46	WRDR3MSM	24.5	2.9 U	2.2 U	1.8 U	1.8 U
364-47	SAR2MSM	55.0	6.0 U	4.5 U	3.6 U	3.6 U
364-48	WRDR2MSM	42.4	5.8 U	4.3 U	3.5 U	3.5 U
364-49	WRR3MSM	41.0	4.9 U	8.0 U	3.0 U	3.0 U
364-50	WRR2MSM	48.0	0.0	8.3 U	0.0	0.0
364-52	WROR1MSM	60.4	3.8 U	8.8	12.0	2.3 U
364-53	SAR3MSM	61.4	3.9 U	12.0	13.9	2.3 U
364-54	OIR3MSM	72.6	3.9 U	17.8	16.7	2.3 U
364-56	OIR1MSM	62.9	3.8 U	10.9	14.9	2.3 U
364-57	OOR3MSM	69.4	3.3 U	7.1	6.5	2.0 U
364-58	PS3R1MSM	61.4	4.1 U	10.4	8.7	2.5 U
364-59	SAR1MSM	77.6	4.0 U	8.7	2.4 U	2.4 U
364-60	WR1MSM	80.8	8.0 U	13.5	4.9 U	4.9 U
364-63, REP 1	BKGMSM	56.1	8.3 U	13.3	5.0 U	5.0 U
364-63, REP 2	MKGMSM	61.7	7.5 U	13.0	4.7 U	4.6 U
364-65	WRR3SNE	60.3	7.6 U	10.7	4.6	4.6 U
364-66, REP 1	BKGSNM	56.5	6.8 U	15.1	1.3	4.1 U
366-66, REP 2	BKGSNM	45.83	6.7 U	11.4	5.1	4.0 U

U = Indicates analyte not detected above detection limits.

11/21/91

WES JF BALDWIN (CF #364)
ORGANOTIN ANALYSIS
OF TISSUE SAMPLES

(concentrationa in ng/g)

MSL Code	Sponsor Code	Tripentyl % Surrogate	Tetra Tin	Tributyl Tin	Dibutyl Tin	Monobutyl Tin
BLANK RESULTS						
Blank-1		27.12	2.5 U	1.9 U	1.5 U	1.5 U
Blank-2		38.37	4.3 U	3.2 U	2.6 U	2.6 U
MATRIX SPIKE RECOVERIES						
364-42 Spike	PS2R3MSM	64.64	1664.9	1556.5	1488.5	162.2
% Recovery			73%	68%	65%	7%
364-47 Spike	SAR2MSM	47.16	1918.7	1379.1	1208.6	159.6
% Recovery			73%	52%	46%	6%

U = Indicates analyte not detected above detection limits.

APPENDIX D

Plant and Animal Mesocosm Test

5. Metal Concentrations in Snail Tissue

Sediment	Sample Number	Sponsor Code
Marine Reference	364-33	MRR3 (marine)
Estuarine Reference	364-15	ER (composite estuarine)
Sand Reference	364-13	Composite (SA estuarine)
	364-14	SAR2 (estuarine)
	364-31	Composite (marine)
	364-32	SAR3 (marine)
Blackrock Harbor	364-29	BRH Composite (marine)
	364-30	BRH R3 (marine)
Pinole Shoal	364-1	PS2 (composite estuarine)
	364-2	PS2R2 (estuarine)
	364-3	PS3R1 (estuarine)
	364-4	PS3 (composite estuarine)
	364-16	PS2 (composite marine)
	364-17	PS2R3 (marine)
	364-18	PS3 (composite marine)
	364-19	PS3R3 (marine)
West Richmond	364-5	WR (composite)
	364-20	WR (composite marine)
	364-21	WRR2 (marine)
	364-22	WRD (composite marine)
	364-23	WRDR2 (marine)

WES - OAKLAND HARBOR (CF #364) 11/22/91

METALS CONCENTRATIONS
IN SNAIL TISSUE SAMPLES

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	%Ca XRF	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP/MS	Cd ICP/MS	Hg CVAA	Pb XRF
364-1	PS2SNE COMP	5.6	10.0	6.7	2390	442	27.5	5.10	6.44	4.09	0.550	2.4
364-2	PS2R2SNE	9.3	10.0 U	3.8	3850	525	27.7	7.17	8.87	3.52	0.718	2.7
364-3	PS3R1SNE	15.3	14.0 U	6.8	2620	454	20.7	5.37	5.35	2.97	0.510	1.9 U
364-4	P23SNE COMP	16.9	15.0 U	5.0	2220	444	24.7	4.09	7.29	2.37	0.518	2.3 U
364-5	WRSNE COMP	8.4	10.0 U	6.3	3060	495	27.0	5.28	5.61	4.39	0.767	1.9 U
364-6	OAP3R1SNE	19.2	17.0 U	6.3	2690	361	23.2	4.92	11.90	1.46	0.419	2.1 U
364-7	OAP3SNE COMP	4.5	8.0 U	3.0	3880	572	31.6	6.26	16.20	4.96	0.948	1.9 U
364-8	OIR2SNE	15.7	15.0 U	7.0	2500	382	23.5	4.27	11.30	2.03	0.461	1.9 U
364-9	OIRSNE COMP	26.9	21.0 U	8.4	1614	241	15.2	3.13	9.96	1.49	0.326	2.4 U
364-10	OOR1SNE	3.4	7.3 U	2.0	3460	589	29.9	6.44	20.80	4.89	0.787	1.8 U
364-12	OOR3SNE	24.8	18.0 U	9.2	2100	274	19.9	4.27	8.03	1.22	0.305	2.2 U
364-13	SASNE COMP	19.2	15.0 U	7.2	2640	394	22.0	4.76	12.90	2.40	0.468	2.2 U
364-14	SAR2SNE	4.2	9.5	8.6	3740	573	32.3	7.32	17.10	5.76	0.946	1.8 U
364-15	ERSNE COMP	24.7	19.0 U	17.1	1951	310	20.3	4.00	12.80	0.98	0.331	2.9
364-16	PS2SNM COMP	16.1	15.0 U	18.1	2570	409	22.2	4.43	12.07	3.84	0.582	2.0 U
364-17	PS2R3SNM	8.2	9.7 U	8.3	3380	537	28.4	6.29	18.60	4.70	0.925	3.1
364-18	PS3SNM COMP	23.0	18.0 U	13.8	2340	403	21.2	4.39	18.80	4.13	0.942	2.2 U
364-19	PS3R3SNM	18.7	17.0 U	21.0	2430	370	30.1	5.15	17.70	6.22	0.674	3.0
364-20	WRSNM COMP	27.4	20.0 U	19.6	1170	302	16.9	1.94	8.28	1.38	0.275	2.5 U
364-21	WRR2SNM	26.7	22.0 U	12.1	1298	263	14.5	2.50	13.90	2.5	0.530	2.5 U
364-22	WRDSNM COMP	40.1	29.0 U	17.1	430	90	8.7	1.20 U	6.51	0.95	0.227	3.1 U
364-23	WRDR2SNM	3.6	7.0 U	2.7	4060	591	30.7	7.64	18.20	5.01	1.094	1.7 U
364-24	OAP3R3SNM	16.0	12.0 U	12.6	2290	406	26.4	4.57	14.60	3.31	0.684	2.0 U
364-25	OIR2SNM	14.9	11.0 U	11.1	2140	486	24.4	4.78	16.50	3.44	0.680	2.0 U
364-26	OIR3SNM	1.3	5.2 U	5.2	3140	487	36.5	7.32	6.62	3.34	0.841	1.7 U

U = Indicates analyte not detected above detection limits.

WES - OAKLAND HARBOR (CF #364)

11/22/91

METALS CONCENTRATIONS IN SNAIL TISSUE SAMPLES

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	%Ca XRF	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP/MS	Cd ICP/MS	Hg CVAA	Pb XRF
364-27	OOR1SNM	4.8	6.6 U	5.5	3220	591	36.0	6.95	13.00	3.61	0.906	1.7 U
364-28	OOR3SNM	2.1	5.3 U	3.9	5020	1177	32.5	9.73	19.70	5.37	1.165	1.7 U
364-29	BRHSNM COMP	21.4	16.0 U	16.6	2690	508	26.3	5.43	14.60	4.28	0.696	4.7
364-30	BRHR3SNM	24.1	17.0 U	23.0	2610	466	27.0	4.50	12.20	2.11	0.332	5.3
364-31	SASNM COMP	29.2	18.0 U	11.6	1874	297	18.0	4.07	15.90	2.36	0.576	2.4 U
364-32	SAR3SNM	27.5	17.0 U	15.0	1805	303	20.2	4.48	13.40	1.30	0.663	2.4
364-33	MRR3SNM	27.2	17.0 U	13.9	1701	295	21.7	4.10	8.56	4.57	0.224	3.1
364-65	WRR3SNE	5.2	9.7 U	9.2	3470	519	26.9	7.37	9.75	4.18	0.656	1.8 U
364-66, Rep 1	BKGSNM	1.0	74.9	13.0	3550	797	17.4	4.31	6.13	1.56	0.221	31.6
364-66, Rep 2	BKGSNM	0.94	44.2	9.1	3820	738	17.0	5.36	1.89	1.51	0.218	21.5
BLANKS												
Blank Rep 1		NA	NA	NA	NA	NA	NA	NA	2.11	3.28	0.001	NA
Blank Rep 2		NA	NA	NA	NA	NA	NA	NA	4.45	0.94	0.001	NA
Blank Rep 3		NA	NA	NA	NA	NA	NA	NA	3.97	1.64	0.002	NA
Blank Rep 4		NA	NA	NA	NA	NA	NA	NA	3.05	0.94	0.002	NA
STANDARD REFERENCE MATERIAL												
1566A-1		0.19	4.0 U	1.8	67.7	834	14.1	2.15	1.51	4.33	0.060	1.3 U
1566A-2		0.19	4.1	1.7	66.2	825	14.0	1.65	1.42	3.97	0.060	1.4 U
1566A-3		0.19	3.7	1.8	69.6	832	13.9	2.20	1.70	4.57	0.059	1.3 U
1566A-4		0.20	4.5	1.7	65.1	816	14.0	2.33	1.61	4.18	0.058	1.4 U
	certified	0.196	1.43	2.25	66.3	830	14	2.21	1.68	4.15	0.064	0.37
	value	±0.019	±0.46	±0.44	±4.3	±57	±1.2	±0.24	±0.15	±0.38	±0.0067	±0.014

NA = Not applicable.
NC = Not certified.
U = Indicates analyte not detected above detection limits.

WES - OAKLAND HARBOR (CF #364) 11/22/91

METALS CONCENTRATIONS
IN SNAIL TISSUE SAMPLES

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	%Ca XRF	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag. ICP/MS	Cd ICP/MS	Hg CVAA	Pb XRF
MATRIX SPIKE RESULTS												
364-16												
Amount Spiked		NA	NA	NA	NA	NA	NA	NA	2	2	0.5	NA
Sample Only		NA	NA	NA	NA	NA	NA	NA	12.07	3.84	0.582	NA
Sample + Spike		NA	NA	NA	NA	NA	NA	NA	8.13	5.62	1.007	NA
Amount Recovered		NA	NA	NA	NA	NA	NA	NA	-3.94	1.78	0.425	NA
Percent Recovery		NA	NA	NA	NA	NA	NA	NA	-197%	89%	85%	NA
364-18												
Amount Spiked		NA	NA	NA	NA	NA	NA	NA	2	2	0.5	NA
Sample Only		NA	NA	NA	NA	NA	NA	NA	18.8	4.13	0.942	NA
Sample + Spike		NA	NA	NA	NA	NA	NA	NA	20.2	6.22	1.358	NA
Amount Recovered		NA	NA	NA	NA	NA	NA	NA	1.4	2.09	0.416	NA
Percent Recovery		NA	NA	NA	NA	NA	NA	NA	70%	105%	83%	NA

U = Indicates analyte not detected above detection limits.

APPENDIX D

Plant and Animal Mesocosm Test

6. Metal Concentrations in Plant Tissue

Sediment	Sample Number	Sponsor Code	Species
Marine Reference	347-21	MRSF (composite)	*Spartina foliosa*
	347-22	MRR3SF	*Spartina foliosa*
	347-23	MRR1SS	*Salicornia subterminalis*
	347-24	MRR2SS	*Salicornia subterminalis*
Estuarine Reference	347-36	ERR1SS	*Salicornia subterminalis*
	347-37	ERR2SS	*Salicornia subterminalis*
	347-38	ERR3SS	*Salicornia subterminalis*
Sand Reference	347-25	SASS (composite)	*Salicornia subterminalis*
	347-33	SAR1SS (estuarine)	*Salicornia subterminalis*
	347-34	SAR2SS (estuarine)	*Salicornia subterminalis*
	347-35	SAR3SS (estuarine)	*Salicornia subterminalis*
Blackrock Harbor	347-10	BRHR1SA	*Spartina alterniflora*
	347-11	BRHR2SA	*Spartina alterniflora*
	347-12	BRHR3SA	*Spartina alterniflora*
	347-18	BRHR1SS	*Salicornia subterminalis*
	347-19	BRHR2SS	*Salicornia subterminalis*
	347-20	BRHR3SS	*Salicornia subterminalis*
Pinole Shoal	347-5	OAP3SF (composite)	*Spartina foliosa*
	347-6	OAP3R3SF	*Spartina foliosa*
	347-13	OAP3SS (composite)	*Salicornia subterminalis*
	347-14	OAP3R1SS	*Salicornia subterminalis*
	347-26	OAPS2 (estuarine)	*Salicornia subterminalis*
	347-27	OAP3R1SS (estuarine)	*Salicornia subterminalis*
	347-28	OAP3R3SS (estuarine)	*Salicornia subterminalis*

METALS CONCENTRATIONS IN PLANTS 10/30/91

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
WORMS												
347-1	BRHCOMP	124.3	12.2	168.2	166.7	6.07	4.66	3.400	7.260	0.765	32.1	22.8
347-2	BRHAMCOMP	83.1	7.46	190.5	150	8.27	4.96	3.100	5.050	0.445	17.5	13.5
347-3 REP 1	OAIUPCOMP	79.4	11.57	19.2	107.1	11.83	3.34	0.102	3.580	0.780	2.62	1.64
347-3 REP 2	OAIUPCOMP	67.5	10.42	20.4	112.1	12.41	3.61	0.099	3.650	0.078	2.46	1.63
347-4	OAOUPCOMP	33.1	8.97	17.2	93.8	11.51	3.74	0.106	3.930	0.078	3.47	2.11
347-39	MANR1	3.2 U	1.85	22.7	175	4.51	3.13	0.032	5.390	0.044	2.3 U	0.872
347-40	MANR2	3.6 U	2.3	24.8	177.1	4.58	3.07	0.023	5.120	0.044	2.4 U	0.842
347-41	MANR3	3.7 U	1.08	23.5	162.9	4.91	3.41	0.005	1.900	0.011	2.1 U	0.226
347-42	MANR4	3.8	2.28	24.1	183.7	4.54	3.39	0.036	6.330	0.041	2.1 U	0.849
PLANTS												
347-5	OAP3SFCOMP	6.2 U	1.81	6.19	34.1	0.61 U	0.45 U	0.146	0.093	0.016	1.49	0.346
347-6 REP 1	OAP3R3SF	6.7	1.10 U	4.89	4.89	0.57 U	0.47	0.080	0.027	0.007	1.5 U	0.095
347-6 REP 2	OAP3R3SF	5.7 U	1.10 U	4.28	4.28	0.45 U	0.48 U	0.081	0.035	0.006	1.6 U	0.094
347-7	OISFCOMP	4.6 U	1.73	6.47	40.4	0.92 U	0.71 U	0.123	0.103	0.012	2.3 U	0.182
347-8	OOSFCOMP	4.0 U	0.85	6.86	108.9	0.97 U	0.72 U	0.100	0.073	0.006	2.5 U	0.259
347-9	OOR2SF	5.9	0.97	7.44	29.2	0.91 U	0.67 U	0.156	0.115	0.023	2.2 U	0.535
347-10	BRHR1SA	12.0	1.68	19.2	52	0.64 U	0.67 U	0.120	0.220	0.025	2.2 U	1.37
347-11	BRHR2SA	5.1	2.72	14.2	53.8	0.98 U	0.74 U	0.089	0.205	0.021	2.5	0.747
347-12	BRHR3SA	4.6 U	2.59	17	51.6	0.94 U	0.72 U	0.144	0.274	0.019	2.3 U	1.14
347-13	OAP3SSCOMP	9.4 U	1.70 U	6.77	20.4	0.96 U	0.96 U	0.012	0.051	0.043	2.9 U	0.247
347-14	OAP3R1SS	7.6 U	1.74	7.7	11.5	0.95 U	1.0 U	0.016	0.027	0.034	3.1 U	0.245
347-15	OIR1SS	10.5	2.07	9.94	20.7	1.3 U	0.94 U	0.020	0.069	0.050	2.9 U	0.394
347-16	OISSCOMP	8.7 U	1.60 U	9.82	20.9	1.3 U	0.93 U	0.012	0.040	0.043	3.2	0.238
347-17	OOSSCOMP	7.8 U	1.55	11	23.5	1.3 U	1.0 U	0.013	0.402	0.049	3.1 U	0.542
347-18	BRHR1SS	8.4 U	1.92	14.6	19.9	0.91 U	0.71 U	0.072	0.277	0.086	3.2	2.25
347-19	BRHR2SS	8.5 U	1.50 U	11.7	15.1	0.6 U	0.62 U	0.053	0.110	0.050	1.9 U	0.994
347-20	BRHR3SS	7.6	1.50 U	21.3	23.5	0.84 U	0.61 U	0.121	0.354	0.049	3.1	3.62
347-21	MRSFCOMP	4.3 U	1.00 U	5.24	29.1	0.47 U	0.5 U	0.095	0.121	0.020	1.6 U	0.199
347-22 REP 1	MRR3SF	5.1 U	1.00 U	4.96	18.3	0.62 U	0.49 U	0.100	0.089	0.016	1.6 U	0.232
347-22 REP 2	MRR3SF	4.7 U	0.10 U	4.79	19.6	0.69 U	0.55 U	0.109	0.096	0.015	1.8 U	0.266
347-23	MRR1SS	9.2 U	3.16	11	24.1	0.86 U	0.69 U	0.008	0.149	0.038	2.2 U	0.318
347-24	MRR2SS	7.8 U	2.80	8.12	24.8	0.72 U	0.61 U	0.012	0.081	0.052	1.8 U	0.155
347-25	SASSCOMP	9.4 U	3.38	14.8	27.3	0.93 U	0.74 U	0.065	0.198	0.064	2.3 U	0.677
347-26	OAP3R1SSE	8.1 U	1.70 U	10.79	13.69	0.84 U	0.7 U	0.020	0.037	0.058	2.1 U	0.388
347-27	OAP3R2SSE	7.5 U	1.60 U	8.32	16.2	0.92 U	0.71 U	0.037	0.079	0.052	2.3 U	0.642

U = Indicates analyte not detected above detection limits.

347METALS.DATA

METALS CONCENTRATIONS IN PLANTS 10/30/91

(concentrations in ug/g (ppm))

Sample Number	Sponsor Code	Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
347-28	OAP3R3SSE	8.7 U	2.46	9.4	17.4	0.87 U	0.65 U	0.016	0.063	0.051	2.2 U	0.584
347-29	OIR1SSE	8.2 U	1.60 U	7.91	17.1	0.83 U	0.66 U	0.015	0.046	0.063	2.1 U	0.288
347-30	OISSCOMPE	6.5 U	2.46	9.56	27.5	1.2 U	0.91 U	0.029	0.093	0.047	2.9 U	0.468
347-31	OOR1SSE	6.1 U	1.10 U	6.28	13.34	1.2 U	0.9 U	0.013	0.072	0.063	3.0 U	0.298
347-32	OOR2SSE	5.8 U	1.68	11.08	21.2	1.2 U	0.9 U	0.026	0.091	0.042	2.9 U	0.515
347-33	SAR1SSE	5.1 U	1.24	8.1	21	1.2 U	0.88 U	0.028	0.069	0.065	2.9 U	0.261
347-34	SAR2SSE	5.9 U	1.2 U	9.08	18.8	1.2 U	0.94 U	0.020	0.055	0.056	3.0 U	0.318
347-35	SAR3SSE	7.0 U	1.5 U	7.68	16.7	1.4 U	1.0 U	0.015	0.103	0.049	3.4 U	0.473
347-36	ERR1SS	6.4 U	1.3 U	6.88	18.7	1.2 U	0.94 U	0.036	0.033	0.058	3.0 U	0.173
347-37	ERR2SS	6.4 U	2.06	5.71	14.6	0.83 U	0.86 U	0.035	0.062	0.069	2.8 U	0.402
347-38	ERR3SS	6.6 U	1.3 U	11.9	27.1	0.95 U	0.96 U	0.026	0.074	0.048	3.1 U	0.388
PROCEDURAL BLANKS												
Blank REP 1		NA	NA	NA	NA	NA	NA	1.40	1.17	0.007	NA	0.93
Blank REP 2		NA	NA	NA	NA	NA	NA	1.86	1.17	0.009	NA	1.4

NA = Not applicable.
U = Indicates analyte not detected above detection limits.

		Cr XRF	Ni XRF	Cu XRF	Zn XRF	As XRF	Se XRF	Ag ICP-MS	Cd ICP-MS	Hg ICP/MS	Pb XRF	Pb ICP-MS
STANDARD REFERENCE MATERIAL												
1566A-1		NA	NA	NA	NA	NA	NA	1.49	3.9	0.06	NA	0.355
1566A-2		3.8 U	2.49	65.8	850	14.86	2.33	1.48	3.75	0.059	1.4 U	0.379
	certified	1.43	2.25	66.3	830	14	2.21	1.68	4.15	0.064	0.37	0.371
	value	±0.46	±0.44	±4.3	±57	±1.2	±0.24	±0.15	±0.38	±0.0067	±0.014	±0.014
1571-1 REP 1		3.8 U	1.27	13.98	28.5	10.84	0.55 U	0.02	0.112	0.109	41.5	41.8
1571-1 REP 2		4.6	1.38	13.1	25.9	9.86	0.57 U	NA	NA		42.2	NA
1571-2 REP1		4.7 U	1.47	13.27	28.7	8.05	0.41 U	0.02	0.108	0.108	44.0	41.5
1571-2 REP 2		4.3 U	1.32	14.01	25.4	9.1	0.43 U	NA	NA		43.1	NA
	certified	NC	1.3	12	25	14	0.08	NC	0.11	0.155	45	45
	value	NC	±0.2	±1	±3	±2	±0.01	NC	±0.02	±0.015	±3	±3

NA = Not applicable.
U = Indicates analyte not detected above detection limits.
NC = Not certified.

APPENDIX D

Plant and Animal Mesocosm Test

7. PAH Concentrations in Plant Tissue

Sediment	Sample Number	Sponsor Code	Species
Marine Reference	347-21	MRSF (composite)	*Spartina foliosa*
	347-22	MRR3SF	*Spartina foliosa*
	347-23	MRR1SS	*Salicornia subterminalis*
	347-24	MRR2SS	*Salicornia subterminalis*
Estuarine Reference	347-36	ERR1SS	*Salicornia subterminalis*
	347-37	ERR2SS	*Salicornia subterminalis*
	347-38	ERR3SS	*Salicornia subterminalis*
Sand Reference	347-25	SASS (composite)	*Salicornia subterminalis*
	347-33	SAR1SS (estuarine)	*Salicornia subterminalis*
	347-34	SAR2SS (estuarine)	*Salicornia subterminalis*
	347-35	SAR3SS (estuarine)	*Salicornia subterminalis*
Blackrock Harbor	347-10	BRHR1SA	*Spartina alterniflora*
	347-11	BRHR2SA	*Spartina alterniflora*
	347-12	BRHR3SA	*Spartina alterniflora*
	347-18	BRHR1SS	*Salicornia subterminalis*
	347-19	BRHR2SS	*Salicornia subterminalis*
	347-20	BRHR3SS	*Salicornia subterminalis*
Pinole Shoal	347-5	OAP3SF (composite)	*Spartina foliosa*
	347-6	OAP3R3SF	*Spartina foliosa*
	347-13	OAP3SS (composite)	*Salicornia subterminalis*
	347-14	OAP3R1SS	*Salicornia subterminalis*
	347-26	OAPS2 (estuarine)	*Salicornia subterminalis*
	347-27	OAP3R1SS (estuarine)	*Salicornia subterminalis*
	347-28	OAP3R3SS (estuarine)	*Salicornia subterminalis*

PAH CONCENTRATIONS IN
PLANT AND WORM TISSUE
(cf# 347)

(Concentrations in ug/kg wet wt)

Sponsor Code:	METHOD BLANK	BRHCOMP	BRHAMCOMP	OAIUPCOMP	OACUPCOMP	OAP3R3SF	COSFCOMP
Sample Number	JM39PB	347-01	347-02	347-03	347-04	347-06	347-08
Species	NA	EARTHWORM	EARTHWORM	EARTHWORM	EARTHWORM	PLANT	PLANT
Wet Weight(g)	10.000	6.513	2.474	4.069	7.987	4.188	1.903
naphthalene	17.088	2.73 JB	16.54 UB	4.49 JB	5.12 UB	26.24 B	21.5 UB
acenaphthylene	4.014 U	9.23	6.33 J	9.87 U	5.03 U	9.59 U	21.09 U
acenaphthene	0.981 J	3.33 U	8.76 U	3.74 J	1.46 J	3.22 J	11.39 U
fluorene	0.891 J	2.04 J	3.19 J	3.23 J	1.04 J	3.2 J	2.48 J
phenanthrene	2.467	24.25	19.66	16.86	4.75	6.2	5.95 J
anthracene	1.777 U	8.14	4.14 J	5.47	2.39	4.24 U	9.34 U
fluoranthene	0.169 J	32.48	25.25	38.07	12.26	3.17 J	2.75 J
pyrene	0.120 J	38.95	34.29	378.65	86.76	3.48 J	3.25 J
benz[a]anthracene	2.968 U	24.59	19.06	27.11	11.95	7.09 U	15.6 U
chrysene	2.080 U	183.54	132.87	57.42	22.52	1.19 J	1.35 J
benzo[b]fluoranthene	3.029 U	215.92	197.25	117.57	33.21	7.23 U	15.92 U
benzo[k]fluoranthene	2.537 U	139.62	90.2	95.5	25.08	6.06 U	13.33 U
benzo[a]pyrene	2.642 U	40.95 M	25.14 M	88.04 M	19.58 M	22.09 M	13.88 U
indeno[1,2,3-c,d]pyrene	3.167 U	4.86 U	12.8 U	7.78 U	3.97 U	7.56 U	16.64 U
dibenz[a,h]anthracene	2.154 U	1.78 J	8.71 U	5.29 U	2.7 U	5.14 U	11.32 U
benzo[g,h,i]perylene	4.295 U	6.6 U	12.67 J	10.59	5.38 U	10.26 U	22.57 U
naphthalene-d8 (% Rec)	73.65	80.29	60.49	66.63	54.28	63.74	61.24
acenaphthene-d10 (% Rec)	85.4 M	92.68 M	69.56 M	84.02 M	68.74 M	82.97 M	72.15 M
benzo[a]pyrene-d12 (% Rec)	61.34	80.29	43.85	63.62	45.52	76.03	68.74

* - Procedural Blank Reported in ng
ND - Non Detected
DO - Diluted Out
J - Value below MDL
U - Not Detected reported as MDL in ng/g
M - Matrix Interference

PAH CONCENTRATIONS IN
PLANT TISSUE
(cf# 347)

(Concentrations in ug/kg wet wt)

Sponsor Code:	OAP3R1SSE	OAP3R2SSE	OIR1SSE	OOR1SSE	OOR2SSE	SAR1SSE	ERR1SS	ERR2SS
Sample Number	347-26	347-27	347-29	347-31	347-32	347-33	347-36	347-37
Species	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT	PLANT
Wet Weight(g)	31.921	30.621	31.144	32.944	13.590	11.249	30.522	23.399
naphthalene	1.28 UB	1.34 UB	1.31 UB	1.24 UB	3.01 UB	3.64 UB	0.62 JB	1.75 UB
acenaphthylene	0.67 J	0.78 J	0.55 J	0.33 J	1.36 J	3.57 U	0.44 J	1.72 U
acenaphthene	0.26 J	0.71 U	0.7 U	0.66 U	2.12	1.93 U	0.71 U	1.04
fluorene	0.41 J	0.4 J	0.37 J	0.45 J	0.88 J	0.69 J	0.58 J	0.46 J
phenanthrene	3.09	3.75	3.42	3.44	4.57	4.16	3.63	3.14
anthracene	0.23 J	0.3 J	0.26 J	0.29 J	0.48 J	0.56 J	0.3 J	0.22 J
fluoranthene	3.39	4.72	4.39	4.1	4.84	5.75	4.08	3.4
pyrene	2.38	4.54	2.86	3.01	3.71	3.3	1.42	2.01
benz[a]anthracene	0.26 J	0.65 J	0.38 J	0.5 J	0.67 J	1.01 J	0.6 J	0.38 J
chrysene	0.77	0.99	0.83	1.02	1.42 J	1.47 J	1.01	0.85 J
benzo[b]fluoranthene	0.95 U	0.99 U	0.97 U	0.92 U	2.23 U	2.69 U	0.99 U	1.29 U
benzo[k]fluoranthene	0.8 U	0.83 U	0.82 U	0.77 U	1.87 U	2.26 U	0.83 U	1.08 U
benzo[a]pyrene	0.83 U	0.86 U	0.85 U	0.8 U	1.94 U	2.35 U	0.87 U	1.13 U
indeno[1,2,3-c,d]pyrene	0.99 U	1.03 U	1.02 U	0.96 U	2.33 U	2.82 U	1.04 U	1.35 U
dibenz[a,h]anthracene	0.68 U	0.7 U	0.69 U	0.65 U	1.59 U	1.92 U	0.71 U	0.92 U
benzo[g,h,i]perylene	1.35 U	1.4 U	1.38 U	1.3 U	3.16 U	3.82 U	1.41 U	1.84 U
naphthalene-d8 (% Rec)	61.49	61.35	58.32	66.46	57.37	70.59	60.88	66.53
acenaphthene-d10 (% Rec)	102.83 M	91.28 M	80.63 M	94.33 M	85.43 M	82.79 M	104.79 M	101.81 M
benzo[a]pyrene-d12 (% Rec)	103.34	97.11	81.48	97.35	83.83	93.73	101.68	93.33

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U - Not Detected reported as MDL in ng
M - Matrix Interference
& - Surrogate Recovery out of range

PAH CONCENTRATIONS IN
PLANT TISSUE
(cf# 347)

(Concentrations in ug/kg wet wt)

Sponsor Code:	ERR3SS
Sample Number	347-38
Species	PLANT
Wet Weight(g)	12.360
naphthalene	3.31 UB
acenaphthylene	3.25 U
acenaphthene	1.75 U
fluorene	0.4 J
phenanthrene	3.64
anthracene	0.52 J
fluoranthene	4.27
pyrene	2.61
benz[a]anthracene	0.58 J
chrysene	0.8 J
benzo[b]fluoranthene	2.45 U
benzo[k]fluoranthene	2.05 U
benzo[a]pyrene	2.14 U
indeno[1,2,3-c,d]pyrene	2.56 U
dibenz[a,h]anthracene	1.74 U
benzo[g,h,i]perylene	3.48 U
naphthalene-d8 (% Rec)	70.9
acenaphthene-d10 (% Rec)	89.87 M
benzo[a]pyrene-d12 (% Rec)	92.33

* - Procedural Blank Reported in ng
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DO - Diluted Out
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U - Not Detected reported as MDL in ng
M - Matrix Interference
& - Surrogate Recovery out of range

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14. ABSTRACT

Construction and improvement of the John F. Baldwin Ship Channel require the dredging and removal of sediment from the West Richmond reach, the Pinole Shoal reach, and the Carquinez Strait. Sediments were sampled and tested to determine the physical and chemical characteristics. Little sediment contamination was found except for elevated levels of polycyclic aromatic hydrocarbons (PAHs) in the West Richmond reach and possible elevated levels of trace metals in Pinole Shoal and Carquinez Strait. The U.S. Army Engineer Research and Development Center evaluated the restoration of levees and wetland creation disposal alternatives. The plant bioassay test results indicated a potential for migration of plant tissue lead into foodwebs associated with the wetland sites. The wetland animal bioassay showed mixed results with plant and animal growth in the mesocosms. Low mussel tissue pesticide concentrations should not cause any concern for foodweb contamination in wetlands created with J.F. Baldwin Project sediments.

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Plant uptake
Wetlands

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